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NORTHEAST ELECTRONICS

A DIVISION OF NORTHERN TELECOM, INC.

INSTRUCTION MANUAL

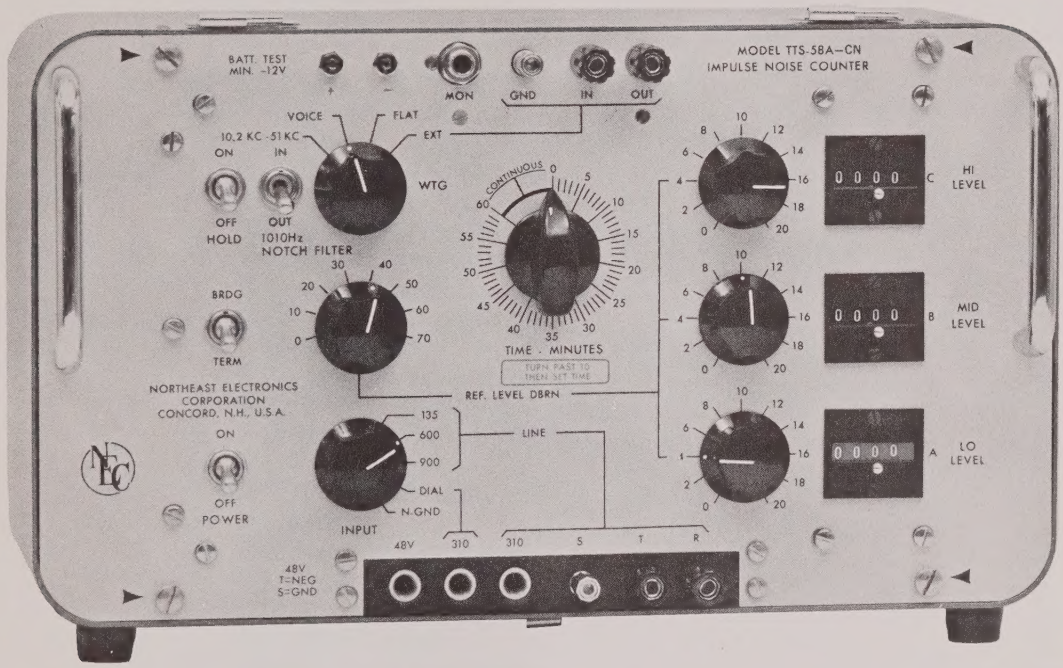
TTS 58A-CN

IMPULSE NOISE COUNTER

No. A0058-10-600 ISSUE 3 DATE AUG. 1976

PRINTED IN U.S.A.

Airport Rd., Concord, N.H. 03301 • (603) 224-6511 • TELEX 94-3453



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SECTION 1

DESCRIPTION

1.1 INTRODUCTION.

1.2 Impulse Noise Counters in the TTS 58A series totalize and display the number of noise impulses that exceed preset levels within a range of 0 to 90 dBrn. The count can be taken continuously, or over a preset length of time using the built-in timer. The TTS 58A Series test sets contain all of the features required for impulse noise tests on audio lines and data channels, including 40.8 kilobit data systems.

1.3 Three, 4-bit counters totalize impulses that exceed the low level only, the low and mid levels only, and all that exceed the high level. For example, assume that the REF LEVEL DBRN switch is set to 70 and the LO, MID, and HI LEVEL 2-dB attenuator threshold switches are set to 2, 6, and 10 respectively. In this case, the channel A low level counter will register all impulses between 72 and 76 dBrn, the channel B mid level counter those between 76 and 80 dBrn, and the channel C high level counter all those above 80 dBrn.

1.4 Three selectable weighting filters produce a flat response up to approximately 5 kHz, an approximate C-message response over the audio range, and a 10.2 to 51 kHz response for use on 40.8 kilobit data systems. Front-panel jacks are available to connect customer-supplied weighting networks (filters) to the test set. These filters must have 600-ohm input and output impedances and an insertion loss of 2 dB to maintain the test set's calibration.

1.5 Both the TTS 58A-CN and TTS 58AR-CN models are equipped with a 1010-Hz notch filter to allow the measurement of noise impulses in the presence of a tone. This filter is switch selectable and can be used with any of the other internal or external filters.

1.6 Circuits having impedances of 135, 600, or 900 ohms can be tested on either a terminated or bridged basis. Internal compensation maintains calibration for all impedance levels.

1.7 A front-panel jack is provided for an external telephone dial that can be used to dial up a quiet termination. An internal hold coil (dc resistance of approximately 500 ohms) can be used to hold a line during a test.

1.8 To further analyze a circuit under test, a 600-ohm headset or an oscilloscope can be used to monitor circuit noise and impulses. A front-panel jack is provided for this purpose.

1.9 TTS 58A-CN models can be operated either on internal batteries or from an external source of 48 volts. The rack-mounted version, TTS 58AR-CN, operates only from an external 48-volt source.

1.10 When it is desired to operate the portable version from an ac line, the TTS 26BXPS Power Supply is available. This unit mounts in the right-hand side of the TTS 58A-CN cover.

SECTION 2

SPECIFICATIONS

2.1 INTRODUCTION.

2.2 Table 2—1 lists specifications for models 58A-CN, 58AR-CN, and the TTS 26BXPS Power Supply cover accessory. Figures 2—1 through 2—4 show response curves for the internal weighting networks and the 1010-Hz notch filter.

Table 2—1. Specifications.

OVERALL RANGE:	0 to 90 dBrn (90 dBrn is defined as 1.1 volts peak into 600 ohms).
ACCURACY:	Typically ±0.25 dB.
REF LEVEL RANGE:	0 to 70 dBrn.
LO, MID, AND HI CHANNEL RANGE:	0 to 20 dBrn above reference dBrn level.
INPUT IMPEDANCE (BALANCED)	
Terminated:	135, 600, and 900 ohms.
Bridging Loss:	Approximately 0.2 dB at 1 kHz into 600 or 900 ohms. Approximately 0.3 dB into 135 ohms.
Noise-to-Ground:	80,000 ohms across line; 100,000 ohms to ground.
FREQUENCY RESPONSE	
Voice:	Approximates C-message filter with 3 dB points at approximately 660 Hz and 3300 Hz. (See Figure 2—1.)
Flat:	Flat response up to 5 kHz with 3 dB points at approximately 40 Hz and 10 kHz; 6 dB per octave slope rolloff. (See Figure 2—2.)
10.2-51 kHz:	Flat response ± 1 dB from 10.2 to 51 kHz. (See Figure 2—3.)
1010 Hz Notch Filter:	±0.5 dB from 100 to 400 Hz and 1700 Hz to 10 kHz. ±3 dB from 400 to 862 Hz and 1182 to 1700 Hz. Greater than −50 dB from 995 to 1025 Hz. Maximum input of +7 dBm into 900 ohms. (See Figure 2—4.)
COUNTING RATE:	10 impulses per second maximum (7 impulses per second optional.)
TIMER:	Variable to 1 hour or continuous.
BATTERY OPERATION:	24, 1.5-volt C cells. In some older units may be 4, 9-volt batteries such as Eveready 2356.

Table 2—1. (cont'd).

BATTERY LIFE:	Exceeds 100 hours in normal use.
48-VOLT OPERATION:	48-volt central office battery at approximately 175 milliamperes.
DIMENSIONS	
TTS 58A-CN:	14 in. w x 10 in. h x 8 in. d. (35.5 cm x 25.5 cm x 20.3 cm).
TTS 58AR-CN:	19 in. w x 8¾ in. h x 8 in. d. (48.3 cm x 22.2 cm x 20.3 cm).
WEIGHT	
TTS 58A-CN:	19.5 pounds (8.9 kg).
TTS 58AR-CN:	15 pounds (6.8 kg).
OPERATING TEMPERATURE:	+5 to +50°C (+41 to +122°F).
TTS 26BXPS POWER SUPPLY	
Output Voltage:	Variable from −44 to −52 volts dc.
Load Current:	750 milliamperes maximum.
Load Regulation:	±1.5 volts.
Ripple:	100 millivolts maximum.

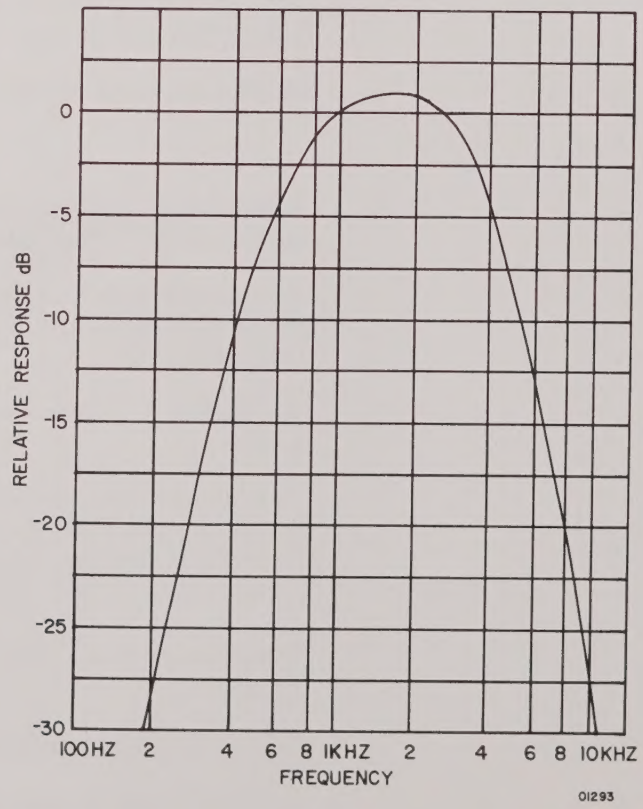


Figure 2—1. Voice Filter Frequency Response Curve.

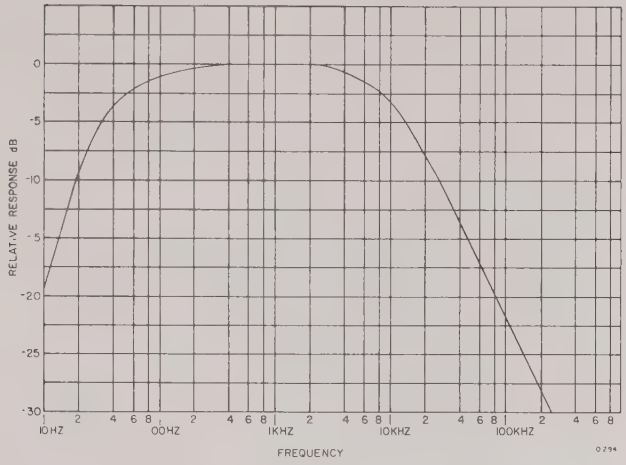


Figure 2—2. Flat Filter Frequency Response Curve.

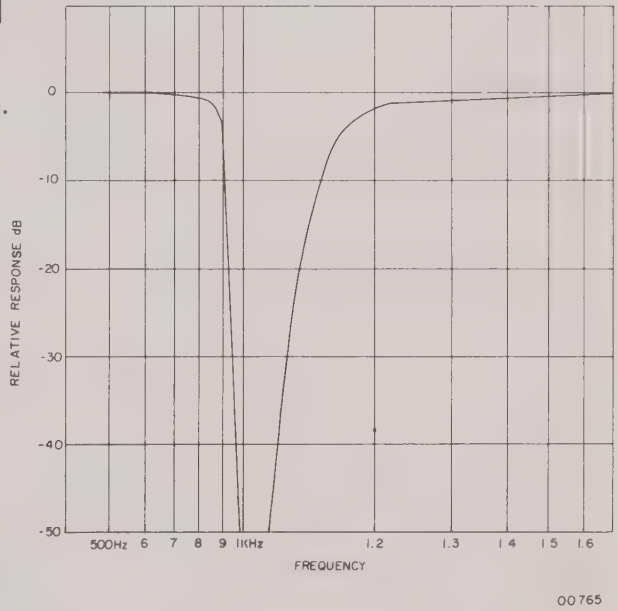


Figure 2—4. 1010 Hz Notch Filter Frequency Response Curve.

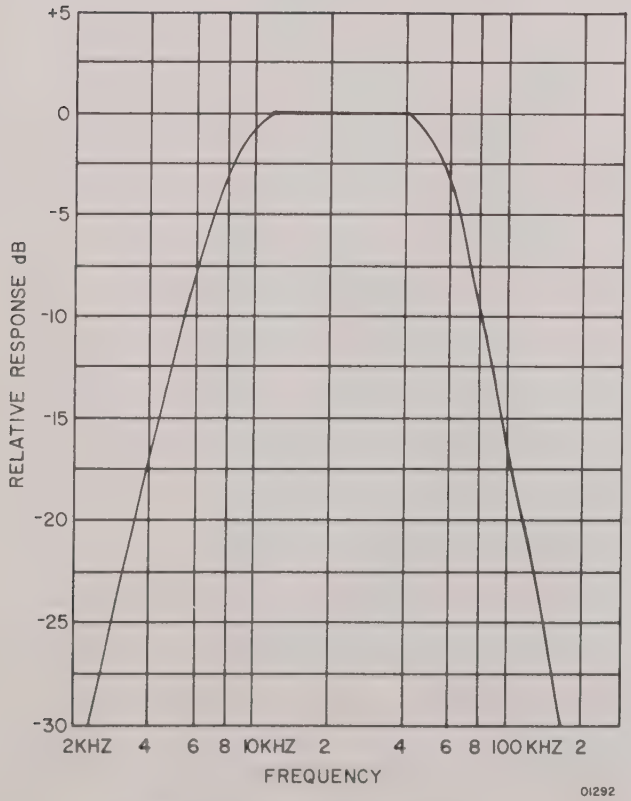


Figure 2—3. 10.2-51 kHz Filter Frequency Response Curve.

SECTION 3

OPERATION

3.1 INTRODUCTION.

3.2 Table 3—1 describes the functions of the front panel controls, indicators, and connectors shown on Figure 3—1. No special installation instructions are required. Paragraphs 3.3 through 3.30 are the operating instructions.

Table 3—1. Front Panel Controls, Indicators, and Connectors.

REF DESIG	CONTROL, INDICATOR, OR CONNECTOR	FUNCTION
BP1	S binding post	Provides parallel connection to sleeve of LINE jack J2.
BP2	GND binding post	Provides ground connection.
J1	DIAL 310 jack	Provides connection for external dial.
J2	LINE 310 jack	Provides connection for line to be tested.
J3	LINE T jack	Provides parallel connection to tip of LINE 310 jack J2.
J4	LINE R jack	Provides parallel connection to ring of LINE 310 jack J2.
J5	48V jack	Provides connection for external 48 volt battery. Tip is −48V and ring is ground.
J6	MON jack	Provides connection for external monitoring.
J7	EXT IN jack	Provides input connections for external weighting network.
J8	EXT OUT jack	Provides output connection for external weighting network.
J9	BATT TEST − jack	Provides connection for negative side of dc voltmeter to check batteries.
J10	BATT TEST + jack	Provides connection for positive side of dc voltmeter to check batteries.
K1	A LO LEVEL counter	4-digit electro-mechanical counter to register peak amplitudes in level range between settings of S4 plus S6 and S4 plus S7.
K2	B MID LEVEL counter	4-digit electro-mechanical counter to register peak amplitude in level range between settings of S4 plus S7 and S4 plus S8.
K3	C HI LEVEL counter	4-digit electro-mechanical counter to register peak amplitudes in level range above setting of S4 plus S8.

Table 3—1. (cont'd).

REF DESIG	CONTROL, INDICATOR, OR CONNECTOR	FUNCTION
S1	INPUT switch	Selects line impedance or connects LINE 310 jack J2 to DIAL 310 jack J1 or selects noise-to-ground measurement mode.
S2	BRDG/TERM switch	Terminates or bridges the line under test with impedance selected by INPUT switch S1.
S3	HOLD switch	When set to ON position, connects low dc resistance hold coil across line.
S4	REF LEVEL DBRN switch	Varies sensitivity of all three counters simultaneously in 10 dB steps from 0 to 70 dBrn.
S5	WTG switch	Selects frequency response of set determined by internal or external weighting network.
S6	LO LEVEL DBRN switch	Varies sensitivity of channel A LO LEVEL threshold in 2 dB steps.
S7	MID LEVEL DBRN switch	Varies sensitivity of channel B MID LEVEL threshold in 2 dB steps.
S8	HI LEVEL DBRN switch	Varies sensitivity of channel C HI LEVEL threshold in 2 dB steps.
S9	POWER switch	When set to ON position, applies power to test set.
S10	1010 HZ NOTCH FILTER switch	When set to ON position, inserts notch filter in series with other weighting networks.
S11	TIME-MINUTES switch	When set, applies power to test set for indicated length of time.

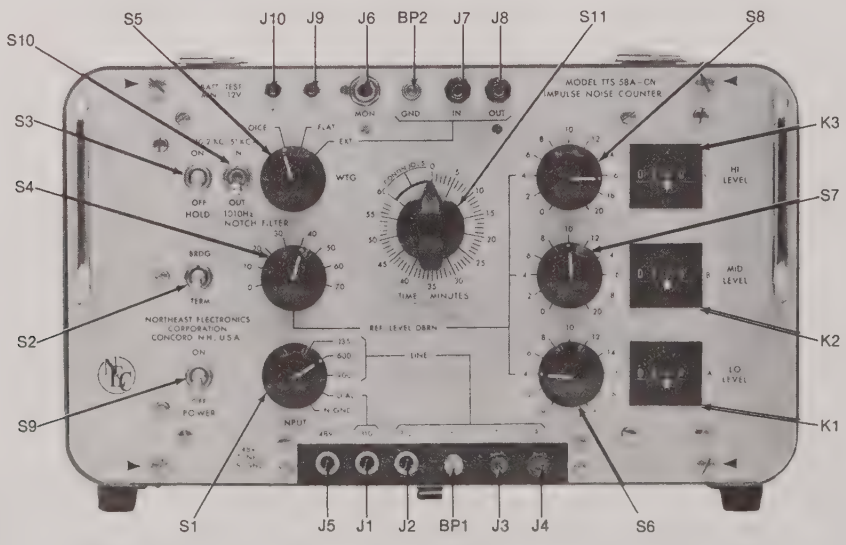


Figure 3—1. Front Panel Controls, Indicators, And Connectors.

3.3 **OPERATION.**

3.4 POWERING THE TEST SET.

3.5 To power the test set using internal batteries perform the following steps.

ACTION	RESULT
a. Set POWER switch S9 to ON position.	
b. Set TIME-MINUTES switch S11 clockwise past 12 then to desired time. For continuous operation, set TIME-MINUTES counterclockwise past click to CONTINUOUS position.	Power is applied to test set.
c. Set LEVEL DBRN switches S4, S6, S7 and S8 so that counters are not counting.	
d. Observing polarity, connect a dc voltmeter to BATT TEST jacks J9 and J10	Fresh batteries will indicate 18 volts. If voltmeter indicates 12 volts or less, replace batteries. Refer to Section 5, paragraph 5.7.

3.6 To power the test set using an external 48 volt source, perform the following steps.

CAUTION

When operating Model TTS 58A-CN from external power source, always insert plug into 48V jack of test set before connecting opposite end to power source. When removing power, always remove power lead from external power source before removing plug from 48V jack on test set.

ACTION	RESULT
a. On test set, insert 310 plug of a power cord into 48V jack J5.	Insertion of plug into 48V jack automatically disconnects internal batteries.
b. Connect power cord to the power source.	
c. Set POWER switch S9 to ON position.	
d. Set TIME-MINUTES switch S11 clockwise past 12 then to desired time. For continuous operation, set TIME-MINUTES control counterclockwise past click to CONTINUOUS position.	Power is applied to test set.
e. Set LEVEL DBRN switches S4, S6, S7 and S8 so that counters are not counting.	

3.7 DIALING AND HOLDING A LINE.

3.8 To dial and hold a line, perform the following steps:

ACTION	RESULT
a. Apply power to test set as instructed in paragraphs 3.4 through 3.6.	
b. Insert line plug into LINE 310 jack J2 or LINE T and R jacks J3 and J4.	Connects line under test to test set.

ACTION	RESULT
c. Insert lineman's handset equipped with plug into DIAL 310 jack J1.	Connects handset to test set.
d. Set INPUT switch S1 to DIAL position	
e. Go off hook with the handset.	
f. Dial desired number.	
g. Place test set HOLD switch S3 at ON position.	
h. Remove lineman's handset.	
i. Place INPUT switch S1 at one of the three LINE positions (135, 600, or 900).	Line is now connected to test circuits and held.

3.9 SELECTING INPUT AND WEIGHTING CIRCUITS.

3.10 To select the input and weighting circuits desired, perform the following steps.

ACTION	RESULT
a. Set INPUT switch S1 to desired impedance.	Selects either 135, 600 or 900-ohm input impedance.
b. Set BRDG/TERM switch S2 to desired position.	Selects either terminated or bridged input impedance.
c. Set WTG switch S5 to desired filter position.	Selects weighting network.

NOTE

If EXT position of WTG switch S5 is used, an external weighting network must be connected across associated EXT jacks J7 and J8. Refer to paragraphs 3.23 through 3.25 for use of external filter.

3.11 SETTING THRESHOLD SENSITIVITY.

3.12 The noise threshold of each channel is a function of the position of REF LEVEL DBRN switch S4 and corresponding channel A LO, B MID, and C HI switches S6, S7, and S8.

CAUTION

When using the test set at or near full sensitivity (low numbers on REF LEVEL DBRN switch S4), do not allow monitor output leads to come near signal input leads. Do not operate the test set in a strong ac magnetic environment when WTG switch S5 is in FLAT position and when HOLD switch S3 is in ON position.

3.13 The three threshold levels must be set in proper relation to each other. To do this, perform the following steps.

ACTION	RESULT
a. Set REF LEVEL DBRN switch S4 and channel A LO LEVEL DBRN switch S6 so that the sum of S4 and S6 is equal to lowest impulse level to be measured.	Channel A LO LEVEL counter totalizes impulse levels between low and middle thresholds.
b. Set Channel B MID LEVEL DBRN switch S7 so that the sum of S4 and S7 is equal to the mid threshold level desired.	Channel B MID LEVEL counter totalizes impulse levels between middle and high thresholds.

ACTION	RESULT
c. Set channel C HI LEVEL DBRN switch S8 so that the sum of S4 and S8 is equal to the highest impulse level to be measured.	Channel C HI LEVEL counter totalizes impulse levels above high threshold.

3.14 When properly set, counter A registers the impulses that exceed the level obtained by summing the settings of REF LEVEL switch S4 and LO LEVEL switch S6, but less than the level obtained by summing the settings of S4 and MID LEVEL switch S7. Counter B registers the impulses that exceed the level obtained by summing the settings of S4 and S7, but less than the level obtained by summing the settings of S4 and HI LEVEL switch S8. Counter C registers all impulses that exceed the level obtained by summing the settings of S4 and S8. For an example, refer to Table 3—2.

Table 3—2. Example of Threshold Settings and Results.

Channel	REF LEVEL DBRN (S4)	LO, MID, HI (S6, S7, and S8) Threshold	Overall Threshold	Final Counter Totals	Counter Interpretation
A	30 dBrn	6 dBrn	36 dBrn	150 on K1	150 impulses > 36 dBrn but < 40 dBrn.
B	30 dBrn	10 dBrn	40 dBrn	125 on K2	125 impulses > 40 dBrn but < 44 dBrn.
C	30 dBrn	14 dBrn	44 dBrn	60 on K3	60 impulses > 44 dBrn.

3.15 SETTING TIMER.

3.16 To set the timer to the desired time duration, perform the following steps.

ACTION	RESULT
a. Set POWER switch S9 to ON position. b. Set TIME-MINUTES switch S11 to desired time.	Power is applied to unit.

3.17 The time duration can be changed at any time by resetting timer switch S11. Once set, the test set operates for the time indicated. Operation can be ended manually by turning the switch counterclockwise to 0 and noting a click. Do not turn past 0 into CONTINUOUS region if test set is to be turned off. To operate the set in the continuous mode, perform the following steps.

ACTION	RESULT
a. Set TIME-MINUTES switch S11 counterclockwise to CONTINUOUS position.	A click is heard and power is applied to unit.
b. To terminate test, set TIME-MINUTES switch S11 clockwise to 0.	A click is heard and power is turned off.

3.18 RESETTING COUNTERS.

3.19 To reset the counters, depress small switch levers located below the individual counters. The resetting of counters should be the last procedure performed before the taking of impulse noise test data.

3.20 MONITORING.

3.21 MON jack J6 has a 600 ohm output impedance. The output can be used to operate a headset, oscilloscope or other device. The open circuit (high-impedance load) output voltage at MON jack J6 is 0.2 volt peak when the impulse level just exceeds the threshold set by REF LEVEL DBRN switch S4. Higher amplitude impulses generate correspondingly higher monitor outputs.

3.22 To monitor the impulse noise level, perform the following steps.

ACTION	RESULT
a. Insert 310 type plug of monitoring device into MON jack J6. **NOTE** Inserting or removing a plug from MON jack J6 may produce an additional count on any or all counters. This is to be avoided when possible. b. At high sensitivities physically separate monitor leads from input leads or use shielded cable. **CAUTION** **The monitor output is dc blocked. Do not apply external voltages exceeding 10 volts.**	Connects monitoring device to test set with common connected to ring and signal connected to tip.

3.23 USING AN EXTERNAL FILTER.

3.24 An external filter used with the test set should have an input and output impedance of 600 ohms and a 2 dB insertion loss. If the external filter has an impedance other than 600 ohms it must be:

a. built out to 600 ohms and the resulting insertion loss determined and used as a correction factor or;

b. it must be determined that the filter can operate with 600 ohms without degradation of filter characteristics.

3.25 To insert and use an external filter circuit, perform the following steps.

ACTION	RESULT
a. On the test set, insert input plug of external filter into IN jack J7, output plug into OUT jack J8 and ground lead to GND binding post BP2.	Connects external filter to test set.
b. Set WTG switch S5 to EXT position.	Selects external filter.
c. If the filter insertion loss is greater than 2 dB, increase all three threshold sensitivity switches S6, S7 and S8 by an amount equal to the insertion loss in excess of 2 dB (i.e., if the filter insertion loss is 4 dB, increase all three threshold sensitivities by 2 dB). Select the value closest to the actual difference.	Makes sure test set calibration is retained.

3.26 MEASURING NOISE TO GROUND.

3.27 To measure noise to ground, set up the test set according to the procedures in paragraphs 3.5 through 3.14, then perform the following steps.

ACTION	RESULT
a. Connect strap between GND binding post BP2 and an office ground.	
b. Set INPUT switch S1 to N-GND position.	
c. Set TIME-MINUTES switch S11 and reset counters.	Timing operation begins and noise impulses to ground are counted.

3.28 MEASURING STEADY NOISE.

3.29 Although TTS 58A Series test sets are not designed for this type measurement, approximate results can be obtained when no other instrument is available. Because the test set measures peak amplitude, and steady noise is measured on a different basis, the definition of REF LEVEL is different and a correction must be made. The correction factor depends on the type of noise being measured. For normal gaussian or white noise, the approximate correction factor is 13 ± 2 dB when comparing VOICE or FLAT measurements made with a TTS 58A Series set to C-message or FLAT 15KC measurements made with other noise measuring sets.

3.30 To measure steady noise, perform the following steps.

ACTION	RESULT
a. Apply power to test set, as instructed in paragraphs 3.4 through 3.6.	
b. Dial and hold line to be tested, as instructed in paragraphs 3.7 through 3.8	
c. Set channel A threshold switch S6 to 0, and B and C threshold switches S7 and S8 to 20.	
d. Starting at 70, set REF LEVEL DBRN switch S4 to the lowest setting that allows continuous, rapid counting on channel A LO LEVEL counter.	
e. Increase channel A attenuator switch S6 in 2 dB steps until count becomes slow and erratic or ceases entirely.	Count must be less than one per second.
f. Decrease channel A attenuator switch S6 by 2 dB.	Count should exceed one per second.
g. Note the sum of the channel A threshold switch S6 and REF LEVEL DBRN switch S4.	
h. Use MON jack J6 to identify the type of signal. An oscilloscope is best for this purpose but a headset will also work.	Either white noise (high-frequency frying pan hiss), power line induction, or tone. For white noise, see step i. For tone or power line induction, see step j.

ACTION	RESULT
i. For white noise, subtract 13 dB from the sum obtained in step g.	Result is approximate steady noise level in dBrn. If S4 is set to 30 and S6 is set to 8, sum of step g is 38 dBrn. Subtract white noise correction factor of 13 dB from 38 dBrn. Steady noise approximation is 25 dBrn.
j. For tone or power induction, subtract 3 dB from step g.	The correction factor depends on the ratio of tone or power induction to the noise.

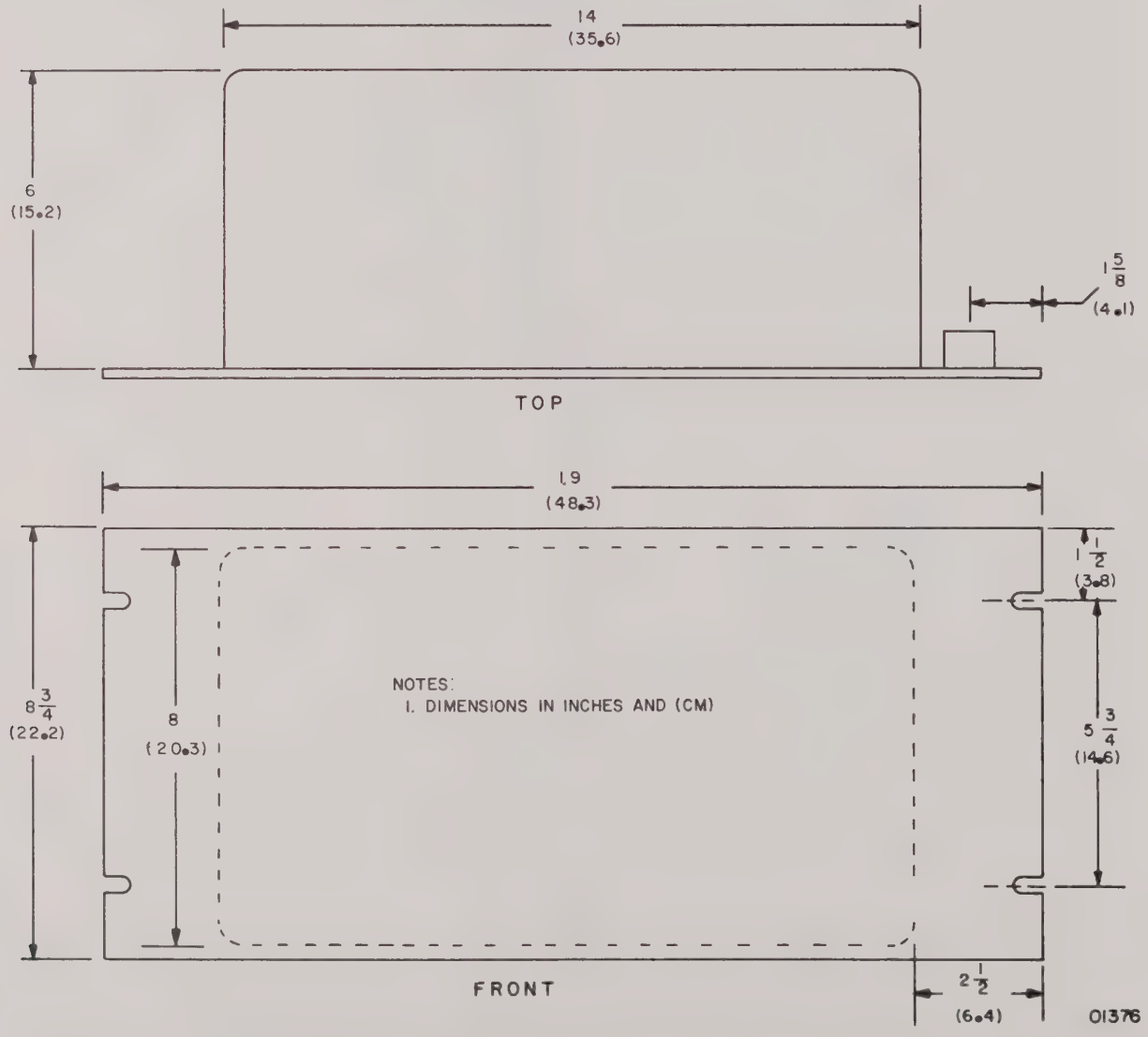


Figure 3—2. Model TTS 58AR-CN Dimensional Outline Drawing.

SECTION 4

THEORY OF OPERATION

4.1 INTRODUCTION.

4.2 This section consists of block diagram level and schematic diagram level descriptions.The test set consists of an analog and power supply section and a digital section.

4.3 BLOCK DIAGRAM DESCRIPTION.

4.4 The block diagram level descriptions are divided into the analog section, digital section, and the power supply.

4.5 POWER SUPPLY SECTION.

4.6 See Figure 4—1 for the analog section block diagram. When using the internal batteries, BT1 is applied through S9B, normally-closed contacts 2 and 5 or J5, and through time delay opening switch S11 to the voltage regulators mounted on PC3. Switch S11 has closed contacts when the switch is set either to the CONTINUOUS position or is running in any of the preset times up to one hour. When the timer reaches 0, the switch contacts open and halt operation. Series regulators Q405 and Q406 provide regulated outputs of −12 and −9 volts for use throughout the unit.

4.7 To operate from an external 48-volt supply, a plug is inserted into J5. The −48 volts on the tip is applied through contact 8 and S9A to reverse-voltage protector diode CR1 on PC2. From there it is applied through R42 to zener diode regulator CR2 and filtered by C25. This voltage is then applied through contacts 6 and 7 and is processed in the same manner as the battery voltage.

4.8 BATT TEST jacks J9 and J10 provide an access to measure the internal battery voltage or the pre-regulated zener output when using an external 48-volt source. The voltage measured at this point must be between 12 and 18 volts when supplied by the batteries and approximately 18 volts when an external source is used.

4.9 ANALOG SECTION.

4.10 The analog section consists principally of input access circuits, filters, amplifier 1, and amplifier 2, and attenuators. The function of the analog section is to provide an access interface with the circuit under test, frequency weighting, and the proper combination of attenuation and gain to establish threshold levels variable in 10 and 2 dB steps from 0 to 90 dBrn.

4.11 **Input Access.** Access to the circuit under test is made through either LINE 310 jack J2 or T and R jacks J3 and J4. The tip and ring are routed through INPUT switch sections S1.1A and S1.1B. For the 135, 600, and 900 ohm positions, the signal is coupled through dc blocking capacitors C1 and C2 to the primary of input transformer T1. Although the capacitors are polarized individually they form a non-polarized unit since they are connected back-to-back. When BRDG/TERM switch S2 is in the TERM position, precision resistors of either 135, 600, or 900 ohms are placed across the tip and ring. In the BRDG position, the high impedance of the transformer primary bridges the line under test. Transformer T1 has switchable primary and secondary windings for the three impedances used. This compensation maintains level calibration for the set regardless of the circuit impedance. When INPUT switch S1 is in the DIAL position, a lineman's handset can be plugged into DIAL 310 jack J1 and a quiet termination can be dialed up. HOLD switch S3 switches low-impedance hold coil L1 across the tip and ring to hold the dialed-up termination.

4.12 In the N-GND position of INPUT switch S1, the noise on the tip and ring is summed and attenuated before further signal processing.

4.13 **Weighting Filter.** The filters are functionally located between amplifiers 1 and 2 and are selected by switch sections S5.1B and S5.1A. The 10.2 to 51 kHz filter is for use on 40.8 kilobit data lines, the voice filter has an approximate C-message characteristic, and the flat filter has a 3-dB bandwidth of from 40 Hz to 10 kHz. All of the filters have an insertion loss of 2 dB. An external filter can be connected between jacks J7 and J8. To be compatible with the test set, the filter must have an insertion loss of 2 dB and 600-ohm input and output impedances.

4.14 To measure noise in the presence of a tone, a notch filter is provided that can be used with any of the other filters. It has a rejection of greater than 50 dB from 995 to 1025 Hz. Some amplification is provided so that the insertion loss is zero.

4.15 **Amplifiers and Attenuators.** The combination of attenuators and amplifiers allows a dynamic noise input range of 90 dB. The switching scheme of REF LEVEL DBRN switch S4 and the fixed amplification of 71 dB is such that the signal level at the output of amplifier 2 is always within the range of −21 to −1 dBm. Table 4—1 shows the attenuation switching scheme for each of the seven positions of REF LEVEL DBRN switch S4. This 20 dB dynamic range at the amplifier output allows an additional 20 dB of attenuation to be selected

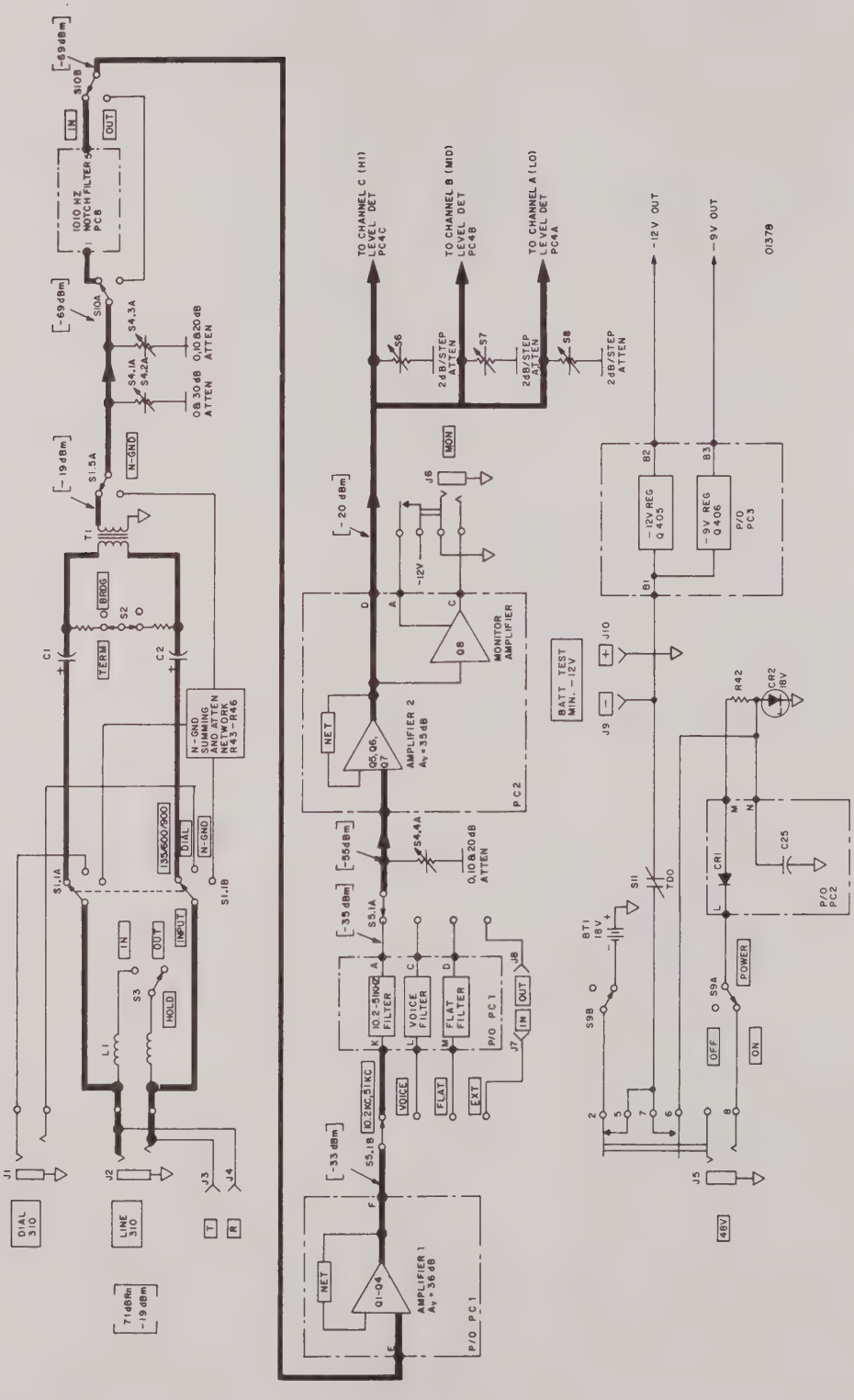


Figure 4—1. Analog And Power Circuits Block Diagram.

in 2 dB steps by the three channel threshold level switches S6, S7, and S8. The output of attenuators S6, S7, and S8 is −21 dBm when it crosses the selected threshold regardless of the input noise level. This signal is then applied to the three threshold detectors in the digital section.

4.16 The output at amplifier 2 is also applied to monitor amplifier Q8 located on PC2. When a plug is inserted into MON jack J6, operating voltage is applied to the monitor amplifier. A 600-ohm output is available for monitoring with a headset or an oscilloscope to further aid in evaluating the impulse noise on the circuit under test.

Table 4—1. Attenuation Switching Scheme.

REF LEVEL DBRN Switch S4 Position	Attenuation (dB) Switched In By:			Total Atten (dB)
	S4.1A and S4.2A	S4.3A	S4.4A	
0	0	0	0	0
10	0	0	10	10
20	0	0	20	20
30	0	10	20	30
40	0	20	20	40
50	30	0	20	50
60	30	10	20	60
70	30	20	20	70

4.17 DIGITAL SECTION.

4.18 See Figure 4—2 for the block diagram of this section. The digital section consists of three identical channels and common timing circuits. See Figure 4—3 for the digital section timing diagram.

4.19 **Start Reset.** To ensure that all digital circuits are in the proper state each time the test set is powered up, a start reset circuit is employed. Approximately 20 to 30 seconds after TIME-MINUTES switch S11 is set in operation, start reset circuit Q501 and Q502 on PC5 generates a negative voltage transition. This is used to trigger timing mono Q401 and Q402 on PC3 so that the Q output produces a 40-millisecond positive pulse. The negative transition at the end of this time then triggers reset mono Q403 and Q404. A positive 60-millisecond pulse is generated and it is the negative transition at the end of this time that is used to reset the set/reset bistables on the channel boards. After reset, the Q outputs of these bistables are in the high state and the digital circuits are now properly conditioned to begin detecting and counting noise impulses.

4.20 **Noise Impulse Detection and Counting.** A description of low level channel A on PC4A will serve as an example for all three channels. When the noise impulse from the LO LEVEL 2 dB attenuator exceeds the threshold level selected, threshold detector Q101, Q102 and diodes CR101 through CR104 produce a negative pulse that sets set/reset bistable Q103-Q104. The negative transition at the Q output is used to trigger the timing mono on PC3 and produce a negative 40-millisecond pulse. This pulse is applied to one input of all AND gates on the channel boards. Assuming that the noise impulse level is not high enough to exceed the threshold of either the mid or high channels, the four inputs to AND gate CR108 through CR111 are all low for a period of 40 milliseconds as determined by the pulse from the timing mono. This causes a negative pulse to be generated and applied to the counter driver that consists of Q105 and Q106. Thus LO LEVEL channel A counter K1 is advanced by one count.

4.21 At least one input to each of the other two AND gates is high during the 40-millisecond timing pulse and the gates are inhibited. This prevents advancement of the other counters. At the end of the timing mono pulse, the reset mono is again triggered and 60 milliseconds later it resets all set/reset bistables and the digital circuits wait for the next noise impulse.

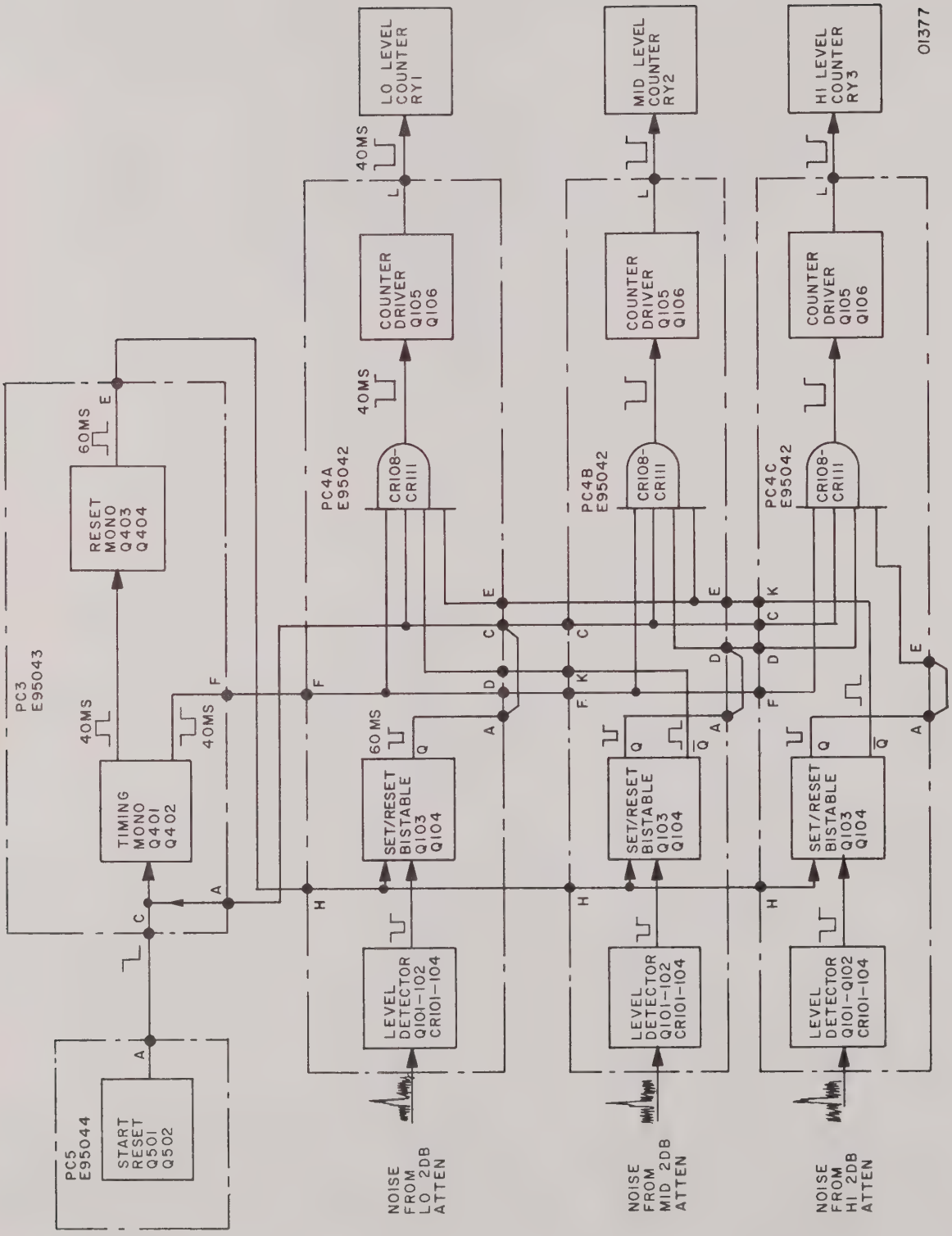


Figure 4—2. Digital Circuits Functional Block Diagram.

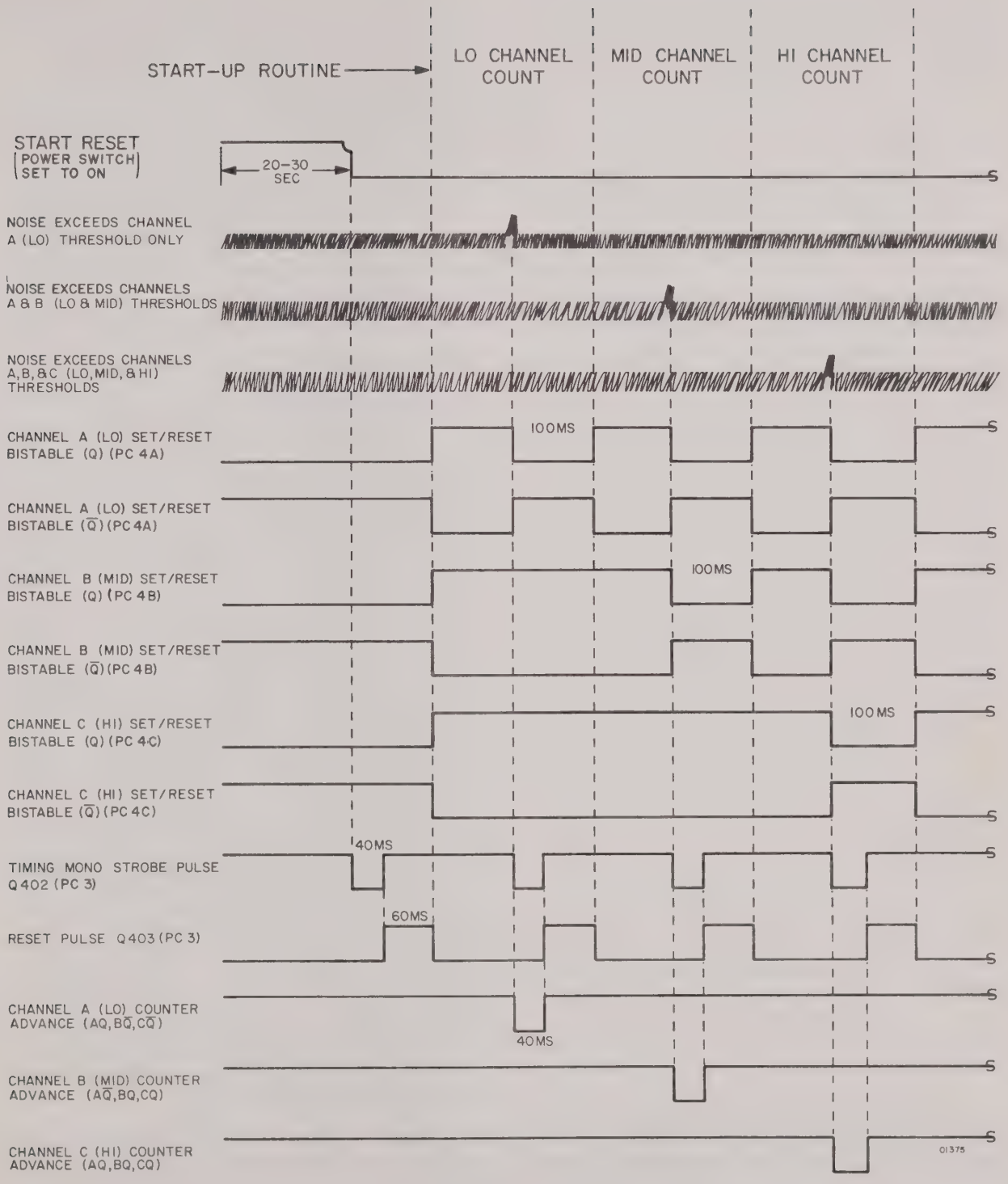

START-UP ROUTINE
LO CHANNEL COUNT
MID CHANNEL COUNT
HI CHANNEL COUNT
START RESET (POWER SWITCH SET TO ON)
20-30 SEC
NOISE EXCEEDS CHANNEL A (LO) THRESHOLD ONLY
NOISE EXCEEDS CHANNELS A & B (LO & MID) THRESHOLDS
NOISE EXCEEDS CHANNELS A,B,&C (LO,MID,& HI) THRESHOLDS
CHANNEL A (LO) SET/RESET BISTABLE (Q) (PC 4A)
100MS
CHANNEL A (LO) SET/RESET BISTABLE (Q̄) (PC 4A)
CHANNEL B (MID) SET/RESET BISTABLE (Q) (PC 4B)
100MS
CHANNEL B (MID) SET/RESET BISTABLE (Q̄) (PC 4B)
CHANNEL C (HI) SET/RESET BISTABLE (Q) (PC 4C)
100MS
CHANNEL C (HI) SET/RESET BISTABLE (Q̄) (PC 4C)
40MS
TIMING MONO STROBE PULSE Q402 (PC 3)
60MS
RESET PULSE Q403 (PC 3)
CHANNEL A (LO) COUNTER ADVANCE (AQ,BQ̄,CQ̄)
40MS
CHANNEL B (MID) COUNTER ADVANCE (AQ̄,BQ,CQ)
CHANNEL C (HI) COUNTER ADVANCE (AQ,BQ,CQ)
01375

Figure 4—3. Digital Circuits Timing Diagram.

4.22 The 100 milliseconds that elapse from the time the impulse is detected until the set/reset bistables are reset determine the maximum counting rate of 10 impulses per second. This allows sufficient time for the counter to advance and recover before the next cycle.

4.23 **DETAILED CIRCUIT DESCRIPTIONS.**

4.24 AMPLIFIER 1 AND FILTERS PC1 (E95048).

4.25 See Figure 6—7 for the schematic diagram of this board.

4.26 **Amplifier 1.** Amplifier 1 is a four-stage circuit comprised of transistors Q1 through Q4 and provides approximately 36 dB of gain. Emitter follower Q1 provides a high input impedance. To stabilize the amplifier gain, negative feedback is taken from the emitter of Q4 and applied to the emitter of Q1 through resistor R18. The ratio of R18 and R17 determines the amplifier gain. Emitter follower Q4 provides a low output impedance of approximately 600 ohms that is set by R23 and R24.

4.27 **10.2-51 kHz Filter.** The bandpass characteristic of this filter is determined by a highpass T section comprised of C10, C11, and L2 and a lowpass pi section comprised of C12, C13, and L3. The response is flat within ±1 dB from 10.2 to 51 kHz. It has 600-ohm input and output impedances and an insertion loss of 2 dB.

4.28 **Voice Filter.** A highpass T section consisting of C14, C15, and L4 and a lowpass pi section consisting of C16, C17, and L5 produce the overall bandpass characteristic. The response curve is an approximation of a C-message filter and has 3 dB points at 660 and 3300 Hz. The input and output impedances are 600 ohms and the insertion loss is 2 dB.

4.29 **Flat Filter.** Capacitor C18 simply restricts the upper 3 dB point to approximately 10 kHz and also provides a rolloff of 6 dB per octave.

4.30 AMPLIFIER 2 AND MONITOR AMPLIFIER PC2 (E95045).

4.31 See Figure 6—9 for the schematic diagram of this board.

4.32 **Amplifier 2.** Amplifier 2 is a three-stage circuit that consists of Q5, Q6, and Q7 and provides approximately 35 dB of gain. Negative feedback is taken from the emitter of Q7 and applied to the emitter of Q5 through R33 and the parallel combination of thermistor TH1 and R37. The total gain of the amplifier is determined by the ratio of R33 plus the equivalent resistance of TH1 and R37 to R32. A small amount of temperature compensation is provided by thermistor TH1. Since this device has a negative temperature coefficient, the gain of the amplifier decreases as the temperature increases. This compensates for the opposite gain temperature coefficient caused by other circuits in the test set.

4.33 **Monitor Amplifier.** The monitor consists of common emitter stage Q8. When a plug is inserted into the MON jack, supply voltage is connected to R39 and the amplifier is activated. The minimum output level of approximately −22 dBm into a 600-ohm load occurs when the noise just exceeds the threshold level set by S4. This reference level output can be as high as −2 dBm.

4.34 TIMING/RESET AND REGULATORS PC3 (E95043).

4.35 See Figure 6—11 for the schematic diagram of this board.

4.36 **Timing/Reset Monostables.** The timing monostable multivibrator consists of Q402 and Q401 while the reset monostable is comprised of Q403 and Q404. The stable state for the timing monostable is with Q402 turned on and Q401 cut off. Either a start reset or timing trigger negative pulse will trigger the timing mono. When this occurs, Q401 is turned on and Q402 is cut off. This unstable state is maintained for approximately 40 milliseconds as determined by the time constant of R406 and C402.

4.37 The negative transition at the end of the 40-millisecond timing pulse is differentiated by C404 and R409 and passed by CR403 to trigger the reset mono. When triggered, Q403 is turned on and Q404 is cut off. The mono remains in this unstable state for approximately 60 milliseconds as determined by the time constant of R413 and C405.

4.38 **Voltage Regulators.** The 9 and 12-volt regulators are of the simple emitter follower type that have zener-regulated base inputs. The 9-volt regulator stage is Q406. Zener diode CR406 provides the base input. The 12-volt regulator is Q405 and CR405 is the zener diode.

4.39 CHANNEL BOARDS PC4A, B, AND C (E95042).

4.40 See Figure 6—13 for the schematic diagram of these boards. The three channels are identical and consist of a threshold detector circuit, a set/reset bistable an AND gate, and a counter driver.

4.41 **Threshold Detector.** The threshold detector circuit consists of input amplifier Q101, phase splitter Q102, and rectifier diodes CR101, CR102, and CR105. Input amplifier Q101 provides a small amount of amplification needed to drive phase splitter Q102. This stage generates emitter and collector signals that are equal in amplitude but out of phase. When the collector is negatve, the signal is passed by diodes CR101 and CR105. When the emitter is negative, it is passed by CR102 and CR105.

The result is a full-wave rectified output of negative polarity at the base of Q103.

4.42 **Set/Reset Bistable.** The reset state of this bistable when it is waiting for a noise impulse is with Q104 conducting and Q103 cut off. When the negative full-wave rectified signal at the anode of CR105 exceeds the turn-on voltage of Q103, the set/reset bistable is set so that Q103 is turned on and Q104 is cut off. The bistable will remain in this state indefinitely until reset. Thus no additional noise impulses are detected during the 100 milliseconds required to generate a reset pulse. At the end of this period, the trailing edge of the reset pulse is differentiated by CR106 and R131, and passed by CR106 to reset the bistable.

4.43 **AND Gate and Counter Driver.** Diodes CR108 through CR111 and resistor R135 form an AND gate. The anodes of CR108, CR109, and CR110 are connected to either the Q or $\overline{Q}$ output of the set/reset bistable on the three channel boards. The timing mono output is connected to the anode of CR111. When the test set is waiting for a noise impulse, the level input at the anode of CR111 is near ground and the junction of R135 and C110 is clamped at approximately ground. When an impulse has been detected, the input to CR111 goes negative. If the inputs to CR108, CR109, and CR110 are all negative during this time, a negative pulse is present at the base of Q105. This causes Q105 to conduct and supply base current for output driver stage Q106, which then conducts to advance the counter. The duration of this pulse is 40 milliseconds and is of sufficient length to allow the counter to mechanically advance one count. A minimum 60-millisecond time period is allowed for the counter coil to completely discharge and for all mechanical motion to come to rest. This turn-on/turn-off cycle is 100 milliseconds and thus limits the maximum count rate to 10 impulses per second. Diode CR112 clamps the collector of Q106 at ground during the inductive kickback pulse caused by the counter coil during turn-off.

4.44 START RESET PC5 (E95044).

4.45 See Figure 6—15 for the schematic diagram. The start reset circuit is a form of monostable utilizing one transistor that is an n-p-n type and another that is a p-n-p. When power is first applied to the test set, Q501 is turned on and its collector voltage drops to −12 volts. This is coupled by C502 and causes Q502 to turn on. Both transistors remain conducting until C502 discharges through R502 to a voltage level that will cut Q502 off and generate a negative transition at its collector. This is approximately 20 to 30 seconds.

4.46 1010-HZ NOTCH FILTER PC8 (E96623).

4.47 See Figure 6—17 for a schematic diagram of the notch filter. Operational amplifier U1 is connected as a unity-gain stage that has a high input impedance. Resistors R3 and R4 match the input and output impedance of the passive notch filter. Output amplifier Q1 and Q2 provides a small amount of gain to compensate for the insertion loss of the passive notch filter. Potentiometer R9 is used to adjust the gain for a unity value measured from input pin 1 to output pin 5 under normal load conditions.

4.48 Transistor Q3 is an emitter follower type voltage regulator that helps to keep power supply variations from effecting the gain of the amplifier stages.

SECTION 5

MAINTENANCE AND CALIBRATION

5.1 INTRODUCTION.

5.2 This section provides service information, recommended test equipment, battery replacement, troubleshooting and calibration instructions.

5.3 SERVICE INFORMATION.

5.4 Each instrument manufactured by Northeast Electronics is warrented for a period of one year upon delivery to the original purchaser. Written authorization is required prior to the return of any equipment for factory repairs. Additional service information can be obtained by contacting Northeast Electronics, Customer Service Department, P.O. Box 649, Concord, New Hampshire, 03301, telephone number 603-224-6511.

5.5 TEST EQUIPMENT.

5.6 Equipment recommended for troubleshooting and calibration of the test set, together with the minimum specifications required for each, is listed in Table 5—1. If the recommended equipment is not available, other equipment that meets the minimum specifications can be used.

Table 5—1. Test and Calibration Equipment.

Equipment Nomenclature	Required Specifications	Recommended Equipment
VOM	Input Impedance: 20k ohms/volt Accuracy: 1.5% full scale Range dc volts: 60 volts	Triplett Model 630NA
Ac Voltmeter	Input Impedance: 500k ohms Range: −70 to 0 dB	HP 400FL
Audio Oscillator	Frequency: 1000 Hz Output Level: 0 dBm Output Impedance: 600 ohms	HP 204C
Step Attenuator	Range: 0 to 70 dB Impedance: 600 ohms	Daven Type VT 795G
Oscilloscope	Vertical Sensitivity: 0.1v/cm Sweep Speed: 10us/cm Probe: X1	Tektronix 561

5.7 BATTERY REPLACEMENT.

5.8 To replace the batteries in the TTS 58A-CN, perform the following steps.

a. On the front panel, loosen the four captive screws that are marked with an arrow.

b. Remove the test set from the case.

WARNING

If the test set has been operating from an external 48-volt source for a considerable length of time prior to removing the cover, avoid contact with R42 and R42A that are located on the left side of the unit. These resistors may be very hot.

c. The battery tray is located in the bottom of the case. Remove the eight battery clips from the batteries of the battery holders.

d. From the inside of the case, remove the four screws that secure the battery tray cover. Remove the cover.

e. Discard the old batteries and replace with fresh ones. Observe the battery polarities as shown on the battery tray cover illustration.

f. Replace battery tray cover and secure with the four screws.

g. Reconnect battery clips.

h. On front panel, connect dc voltmeter to + and − BATT TEST jacks.

i. Set POWER switch to ON position.

j. Set TIME-MINUTES control counterclockwise past click to CONTINUOUS position. The voltmeter should indicate the battery voltage. Fresh batteries should indicate approximately 18 volts; 12 volts is the absolute minimum.

k. Insert unit into case and secure with the four front-panel screws.

5.9 TROUBLESHOOTING.

5.10 As aids to troubleshooting, waveforms and dc voltages at significant points are provided on the schematic diagrams in section 6. The instrument consists of an analog section that is common to all three digital threshold detector and counter channels and a common power supply section. Troubleshooting down to a plug-in card level is accomplished by using the two block diagrams and the timing diagram provided in Section 4. Detailed troubleshooting can then be performed to a specific circuit by using the waveforms and the dc voltages provided on the schematic diagrams.

5.11 CALIBRATION.

5.12 The following calibration procedure applies to all versions of the TTS 58A Series. To calibrate these test sets, perform the following steps.

a. Set POWER switch to ON.

b. Connect dc voltmeter to BATT TEST + and − jacks.

c. Set TIME-MINUTES control counterclockwise past click to CONTINUOUS.

d. Voltmeter must indicate at least 12 volts if internal batteries are being used or 18 volts if an external 48-volt source is being used. If batteries are being used and the voltage is low, replace the batteries as indicated in paragraph 5.7.

e. Connect the test equipment as shown on Figure 5−1. Refer to Table 5−1 for a list of recommended test equipment.

f. Set external step attenuator to 0 dB.

g. Set audio oscillator frequency to 1000 Hz and adjust the output level to obtain an indication of 0 dBm into 600 ohms on ac voltmeter.

h. Set attenuator controls to obtain a −43 dBm signal level into the test set.

i. Set INPUT switch to 600.

j. Set BRDG/TERM switch to TERM.

k. Set WTG switch to VOICE.

l. Set HOLD switch to OFF.

m. Set REF LEVEL DBRN switch to 50.

n. Set channel A LO LEVEL threshold sensitivity to 0, channel B MID LEVEL to 10, and channel C HI LEVEL to 20.

o. Adjust potentiometer R111 (Figure 6−2) counterclockwise until channel A counter stops counting and then clockwise until counter just starts to count. Lock potentiometer in this position.

p. Set step attenuator controls to obtain a −33 dBm

signal level at test set input.

q. Adjust potentiometer R211 (Figure 6—2) counter-clockwise until channel B counter stops counting and then clockwise until counter just starts to count. Lock potentiometer in this position.

r. Set the step attenuator controls to obtain —23 dBm signal level at test set input.

s. Adjust potentiometer R311 Figure 6—2) counter-clockwise until channel C counter stops counting and then clockwise until counter just starts to count. Lock potentiometer in this position.

t. Place a drop of glyptol on each potentiometer to firmly secure the adjustment.

u. Remove all test equipment.

v. Replace test set in the case.

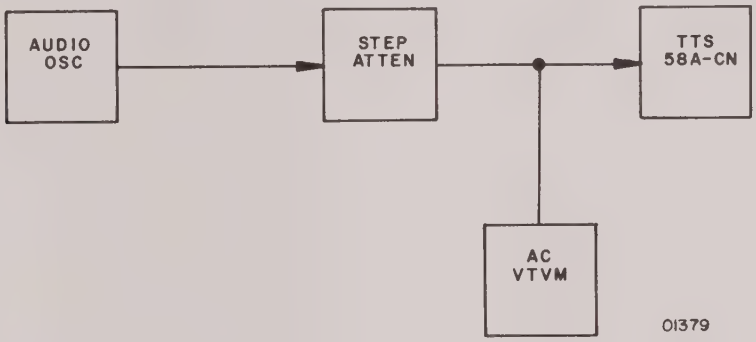


Figure 5—1. Calibration Test Setup.

SECTION 6

DIAGRAMS

6.1 INTRODUCTION.

6.2 This section contains the assembly location, component location and the schematic diagrams for the TTS 58A-CN and TTS 58AR-CN.

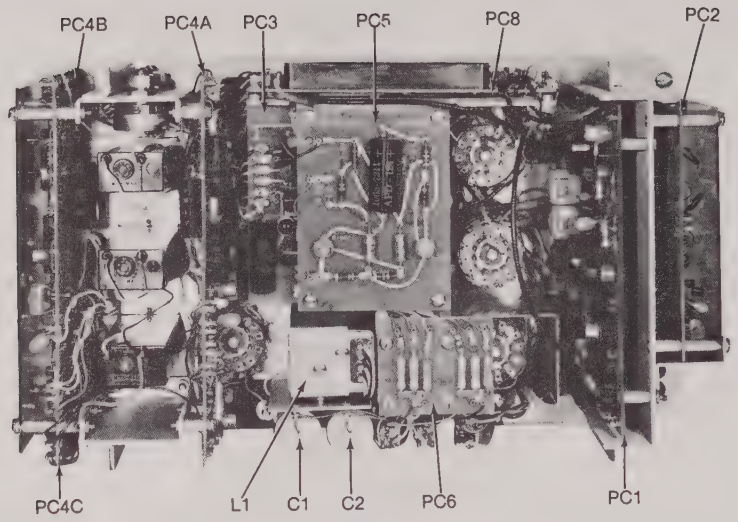


Figure 6—1. Model TTS 58A-CN Rear View, Assembly Location.

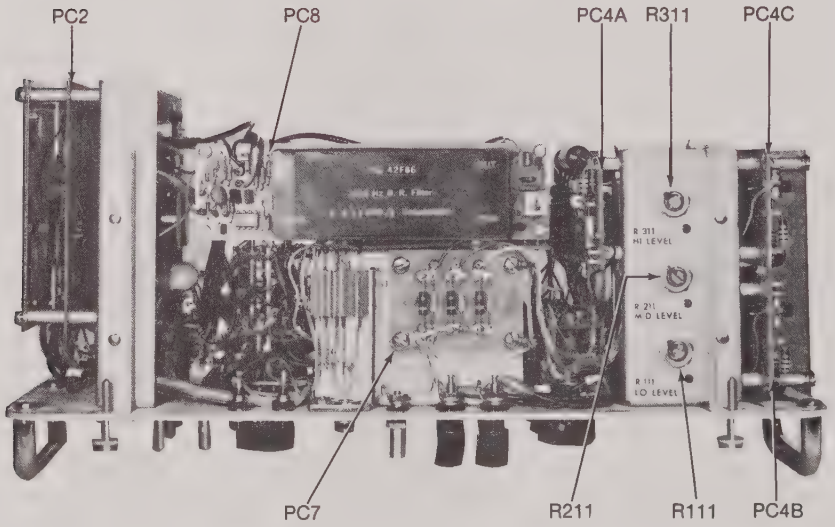


Figure 6—2. Model TTS 58A-CN Top View, Assembly Location.

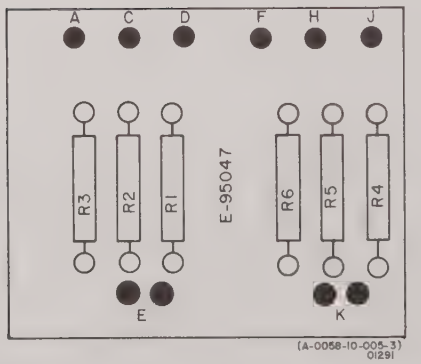


Figure 6—3. Input Termination PC6 (E95047) Component Location Diagram.

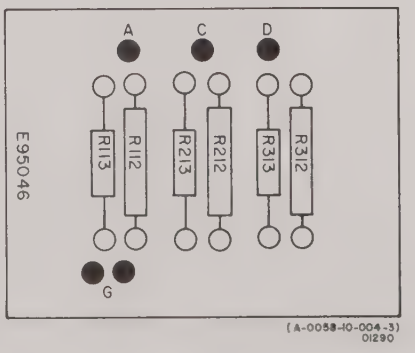
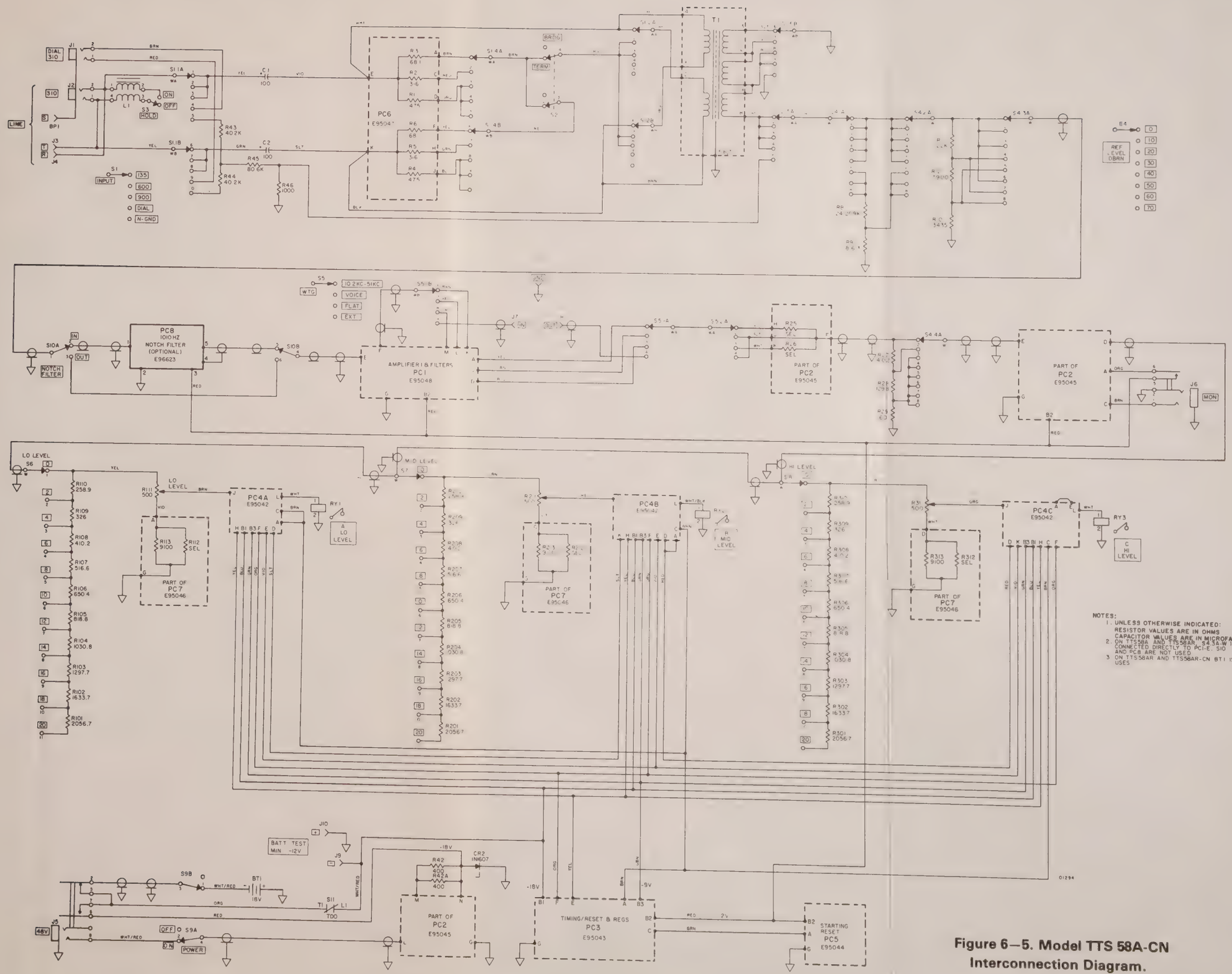


Figure 6—4. Attenuator Padding PC7 (E95046) Component Location Diagram.



NOTES:
1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS
   CAPACITOR VALUES ARE IN MICROFARADS.
2. ON TTS58A AND TTS58AR, S4 3A-W IS CONNECTED DIRECTLY TO PC1-E, S10 AND PC8 ARE NOT USED.
3. ON TTS58AR AND TTS58AR-CN BT1 IS NOT USED.

Figure 6—5. Model TTS 58A-CN Interconnection Diagram.

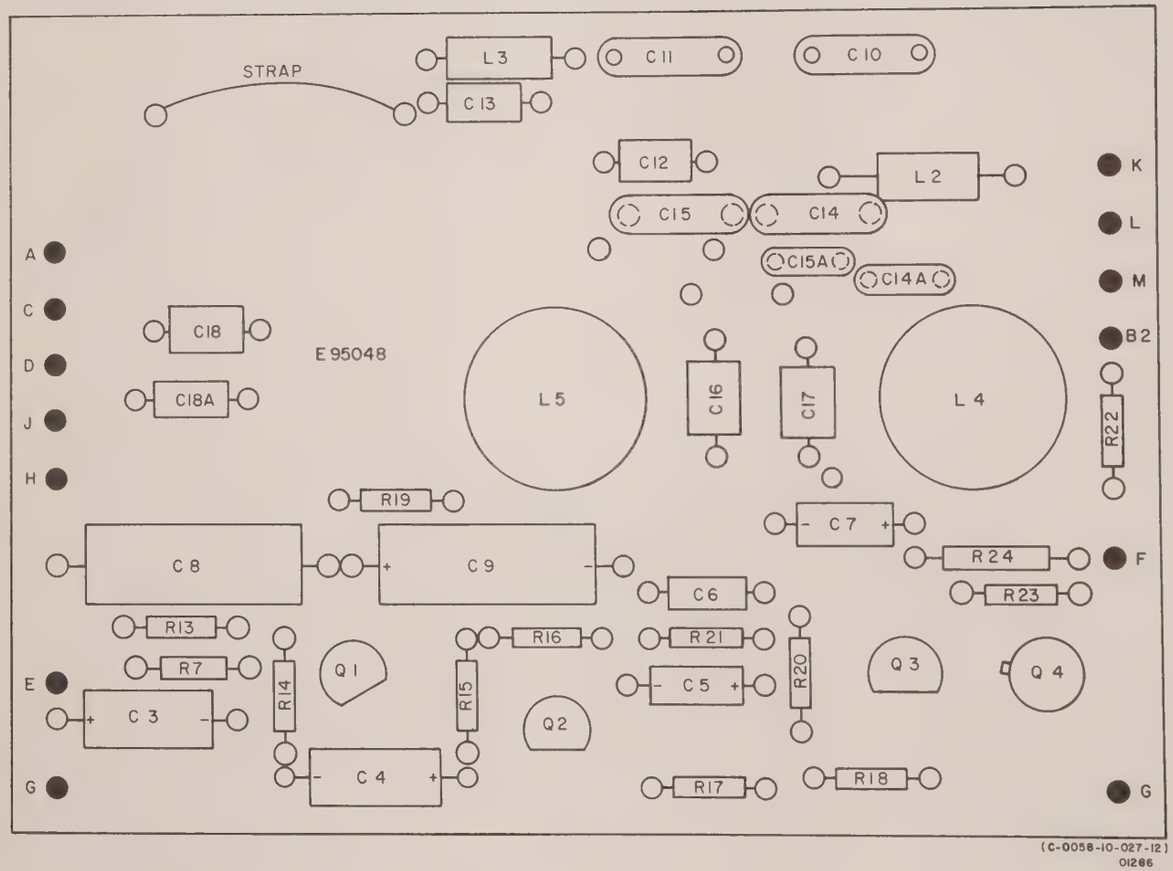
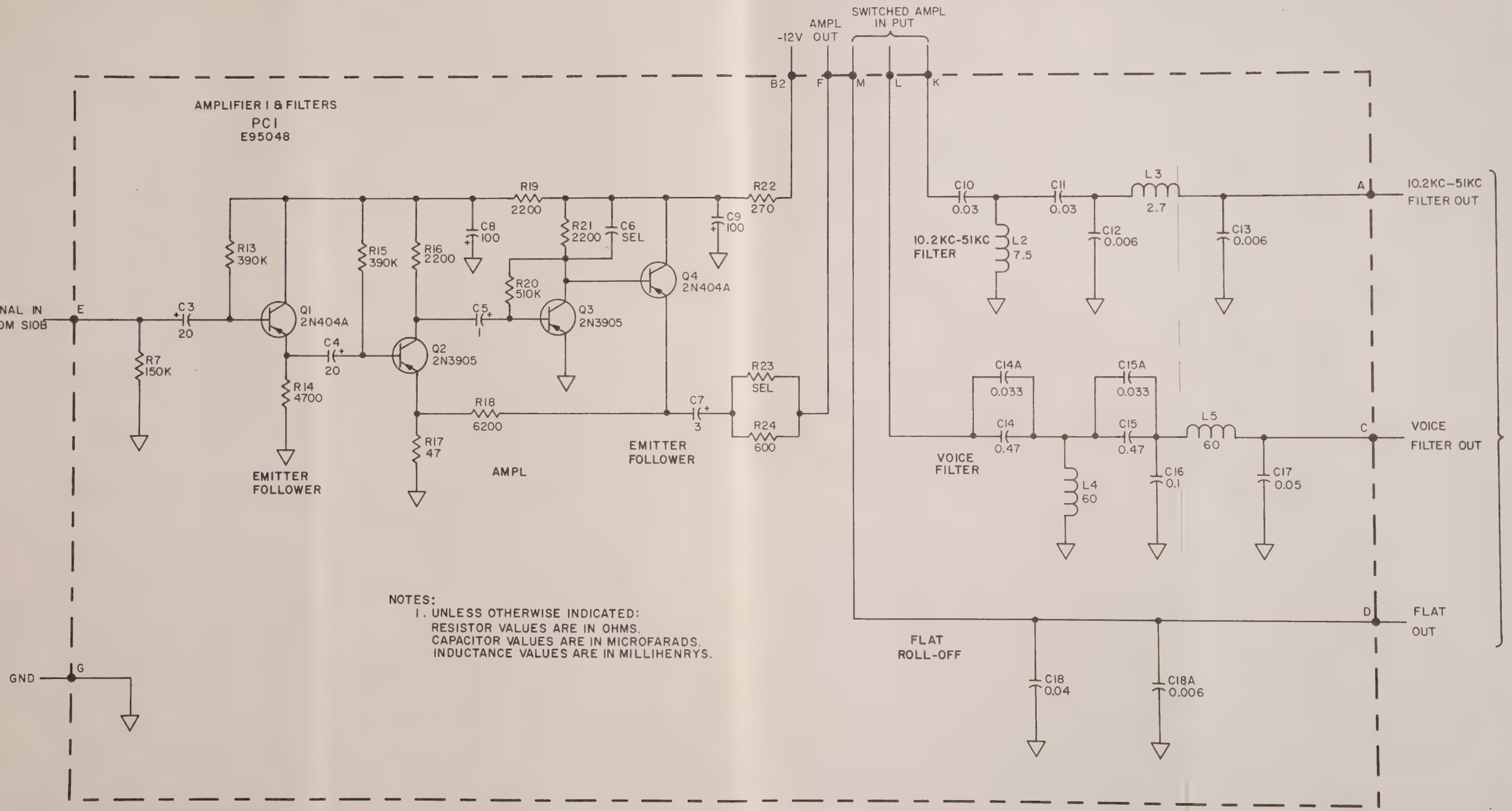


Figure 6—6. Amplifier 1 And Filters PC1 (E95048) Component Location Diagram.



NOTES:
1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS.
   CAPACITOR VALUES ARE IN MICROFARADS.
   INDUCTANCE VALUES ARE IN MILLIHENRYS.

Figure 6–7. Amplifier 1 And Filters PC1 (E95048) Schematic Diagram.

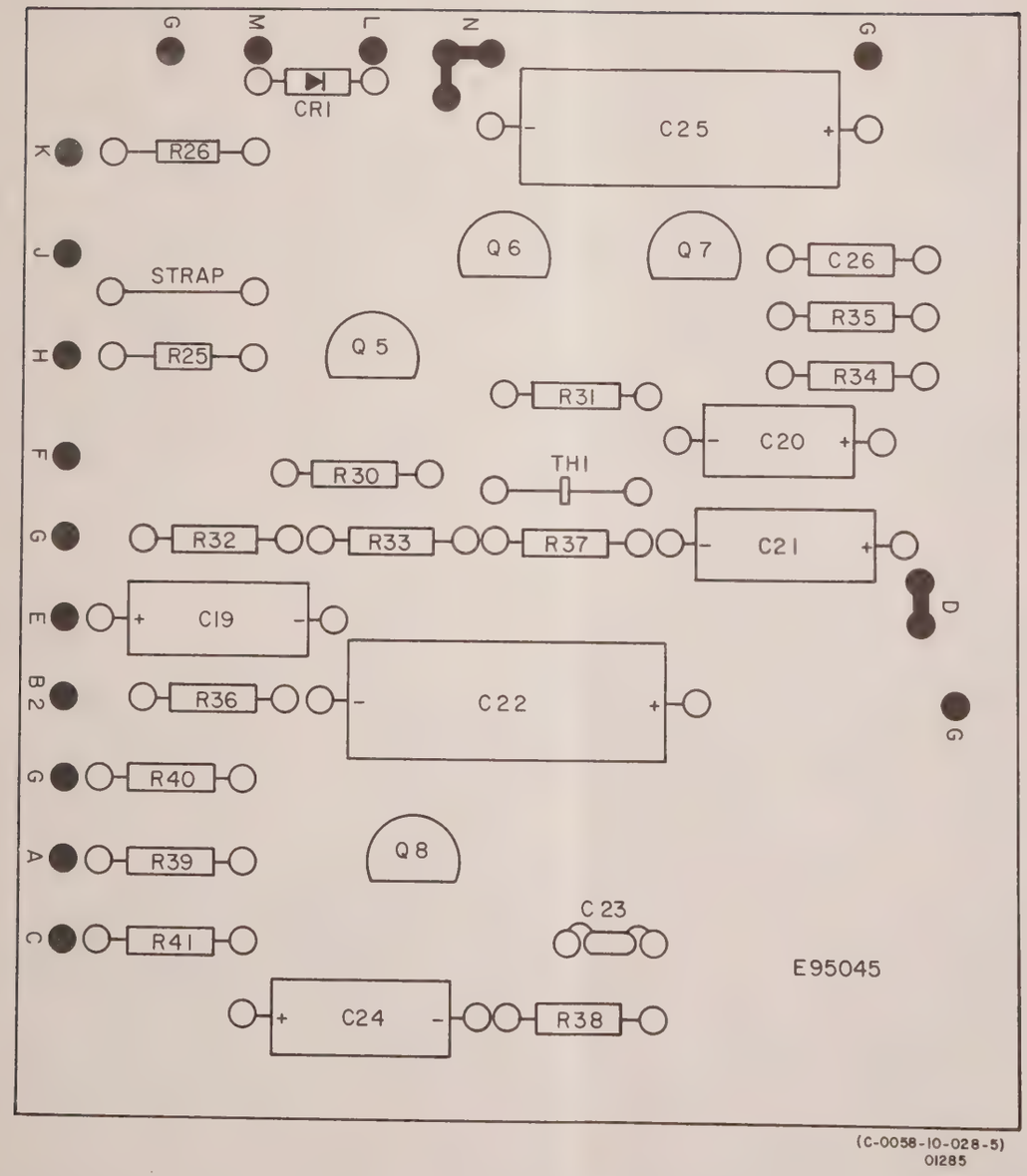


Figure 6—8. Amplifier 2 And Monitor Amplifier PC2 (E95045) Component Location Diagram.

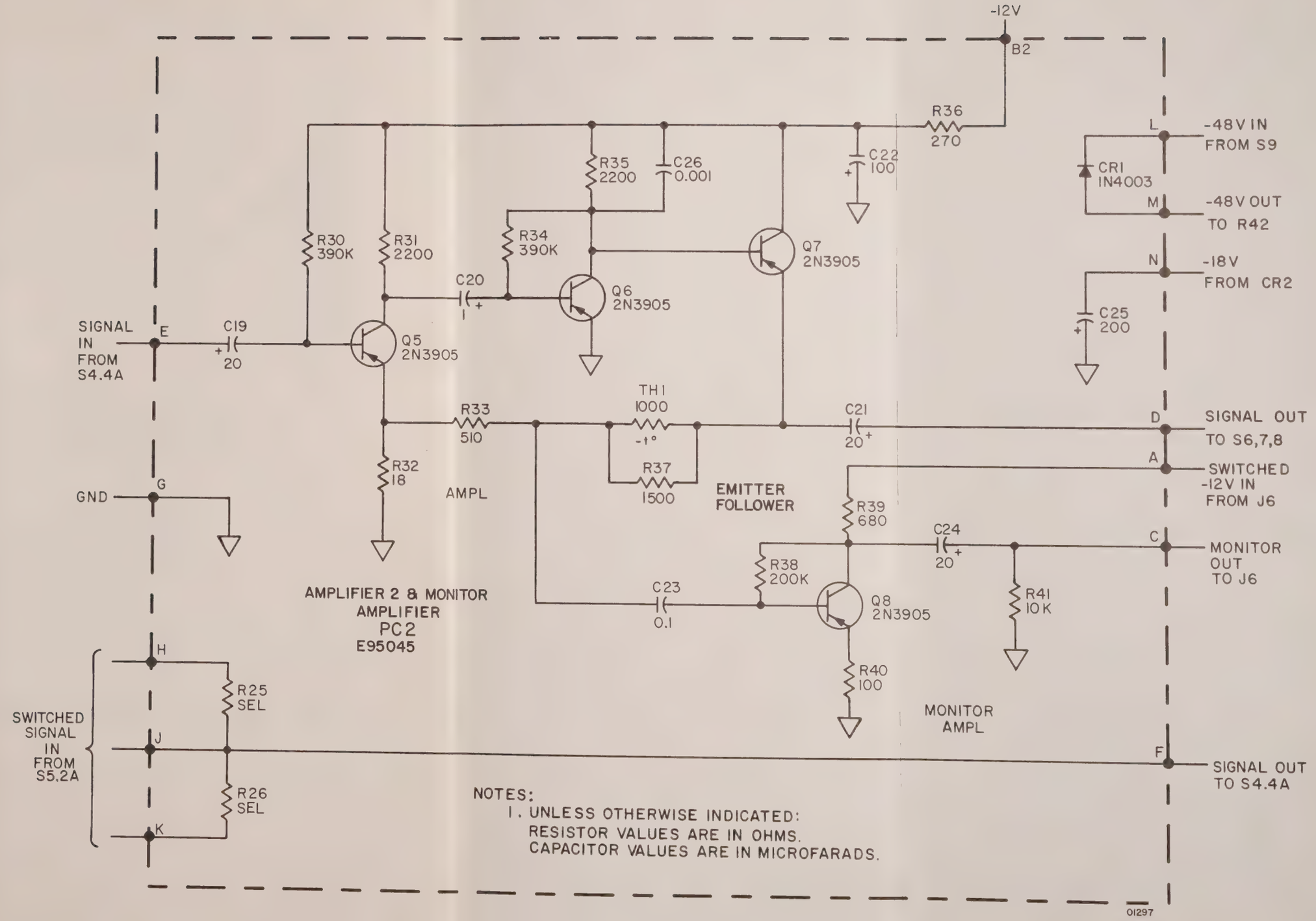


Figure 6—9. Amplifier 2 And Monitor Amplifier PC2 (E95045) Schematic Diagram.

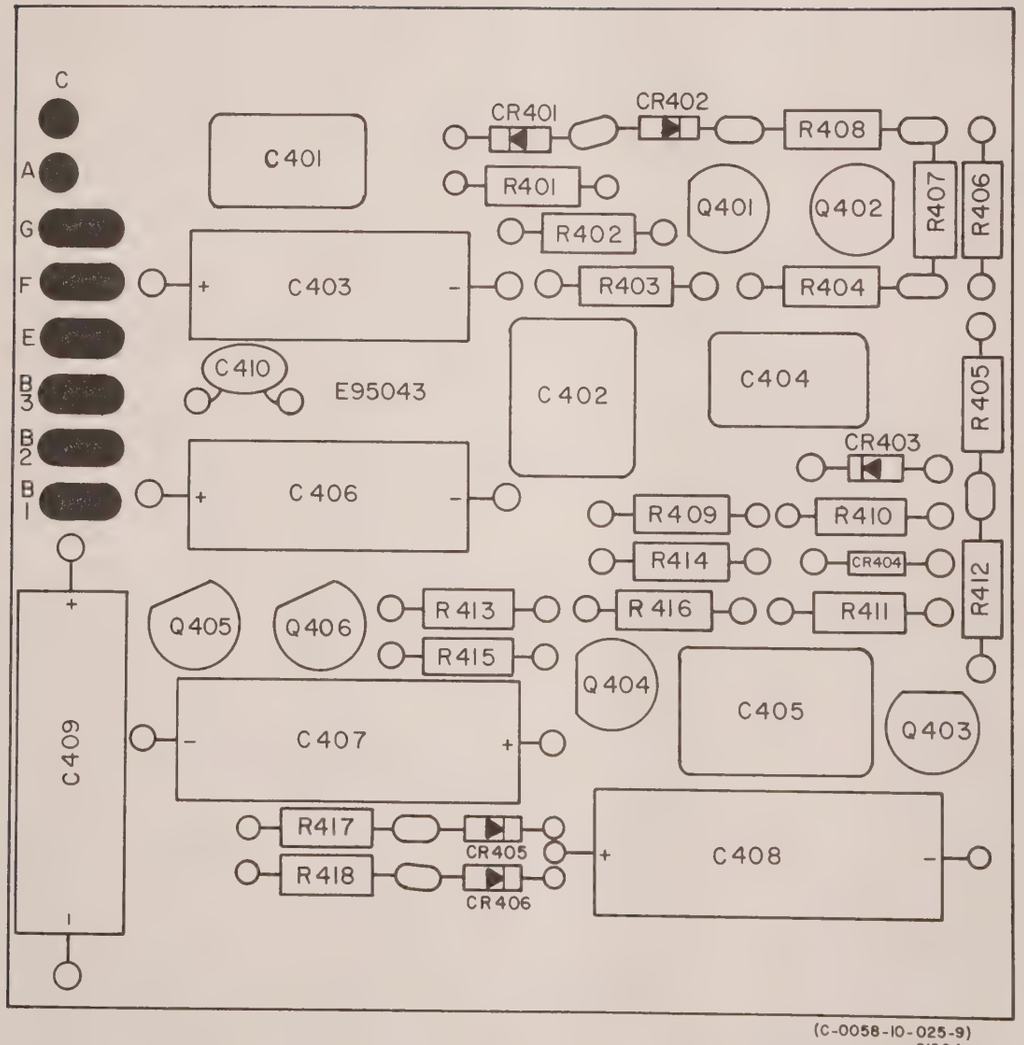


Figure 6—10. Timing/Reset And Regulators PC3 (E95043) Component Location Diagram.

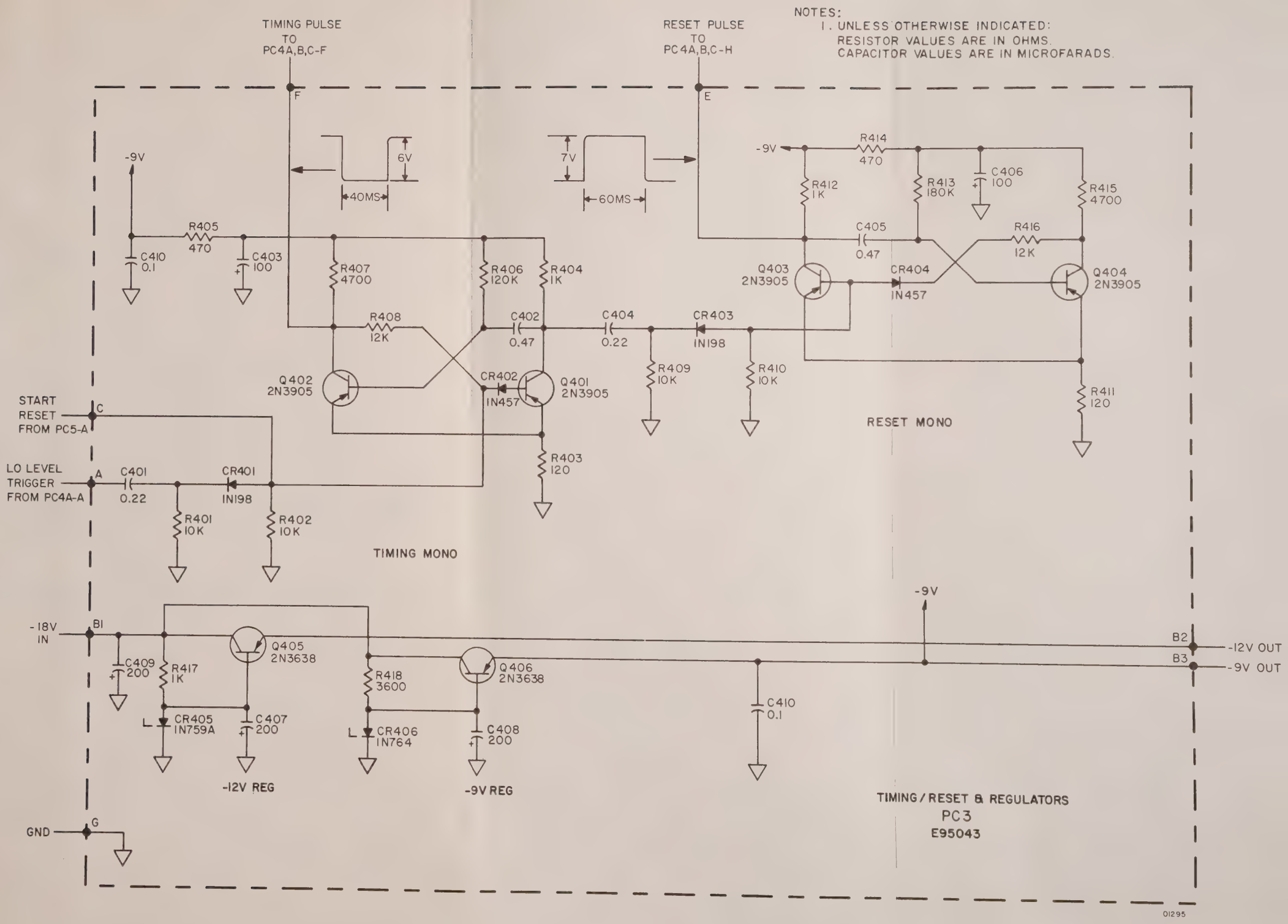


Figure 6—11. Timing/Reset And Regulators PC3 (E95043) Schematic Diagram.

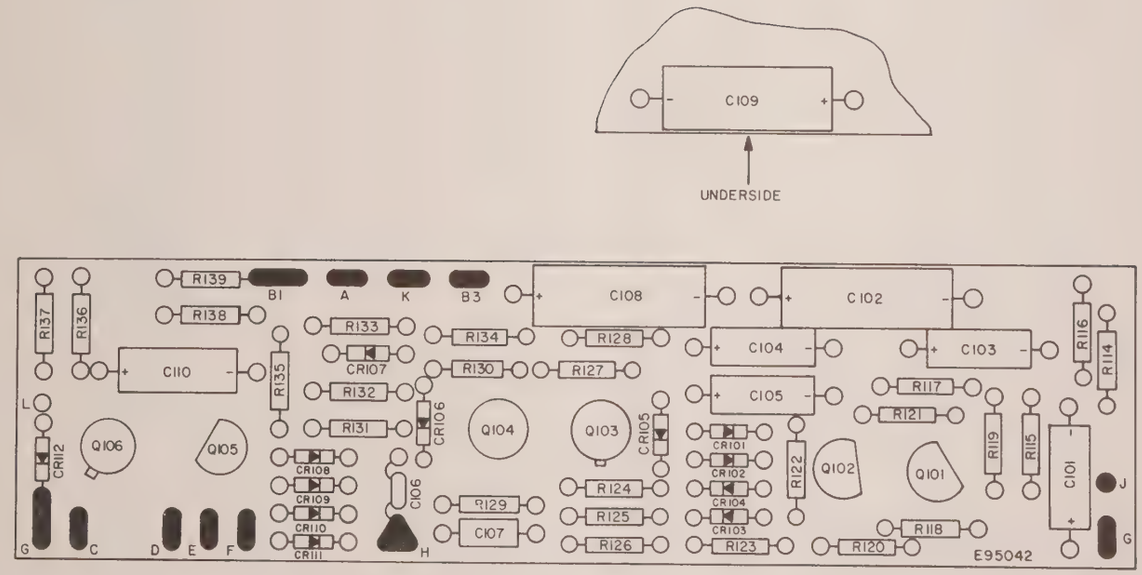
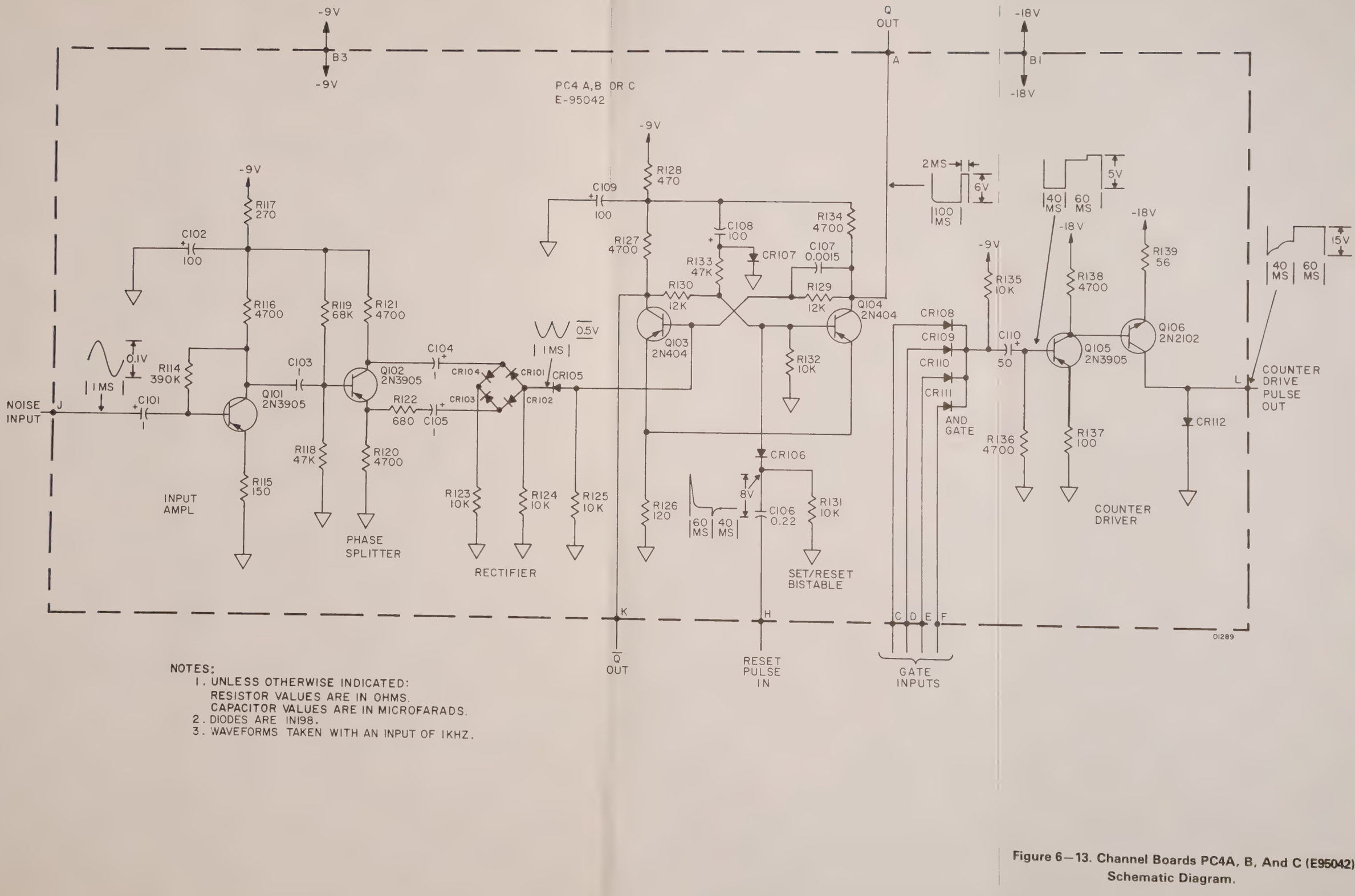
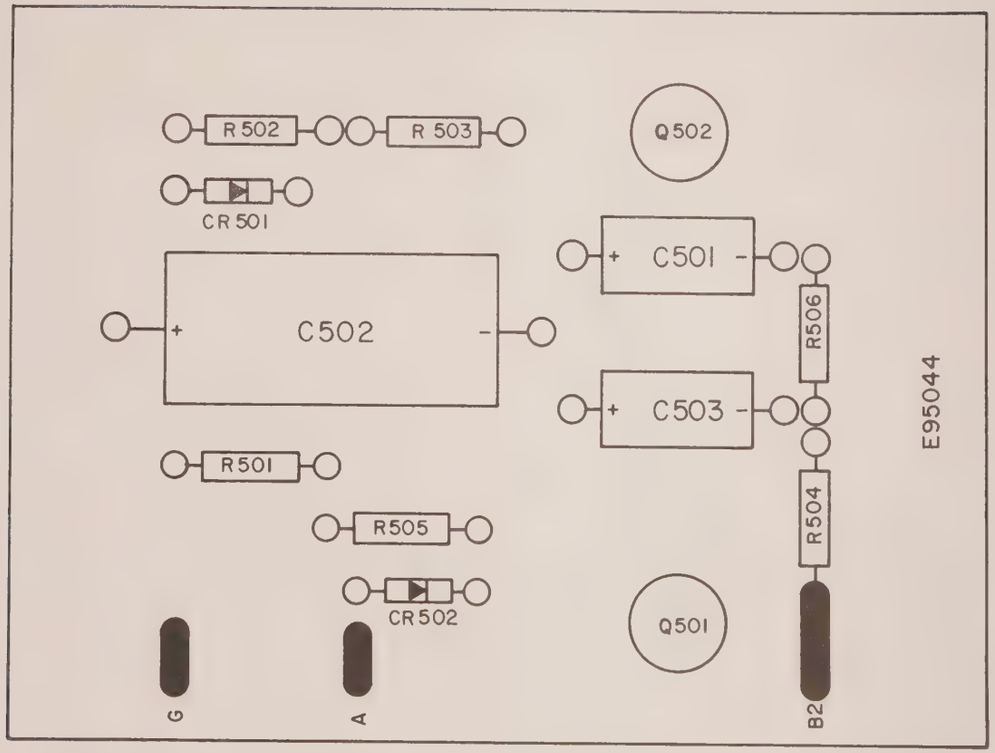


Figure 6—12. Channel Boards PC4A, B, And C (E95042) Component Location Diagram.



NOTES:
1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS.
   CAPACITOR VALUES ARE IN MICROFARADS.
2. DIODES ARE IN198.
3. WAVEFORMS TAKEN WITH AN INPUT OF 1KHZ.

Figure 6—13. Channel Boards PC4A, B, And C (E95042) Schematic Diagram.



(B-0058-10-023-1)
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Figure 6—14. Starting Reset PC5 (E95044) Component Location Diagram.

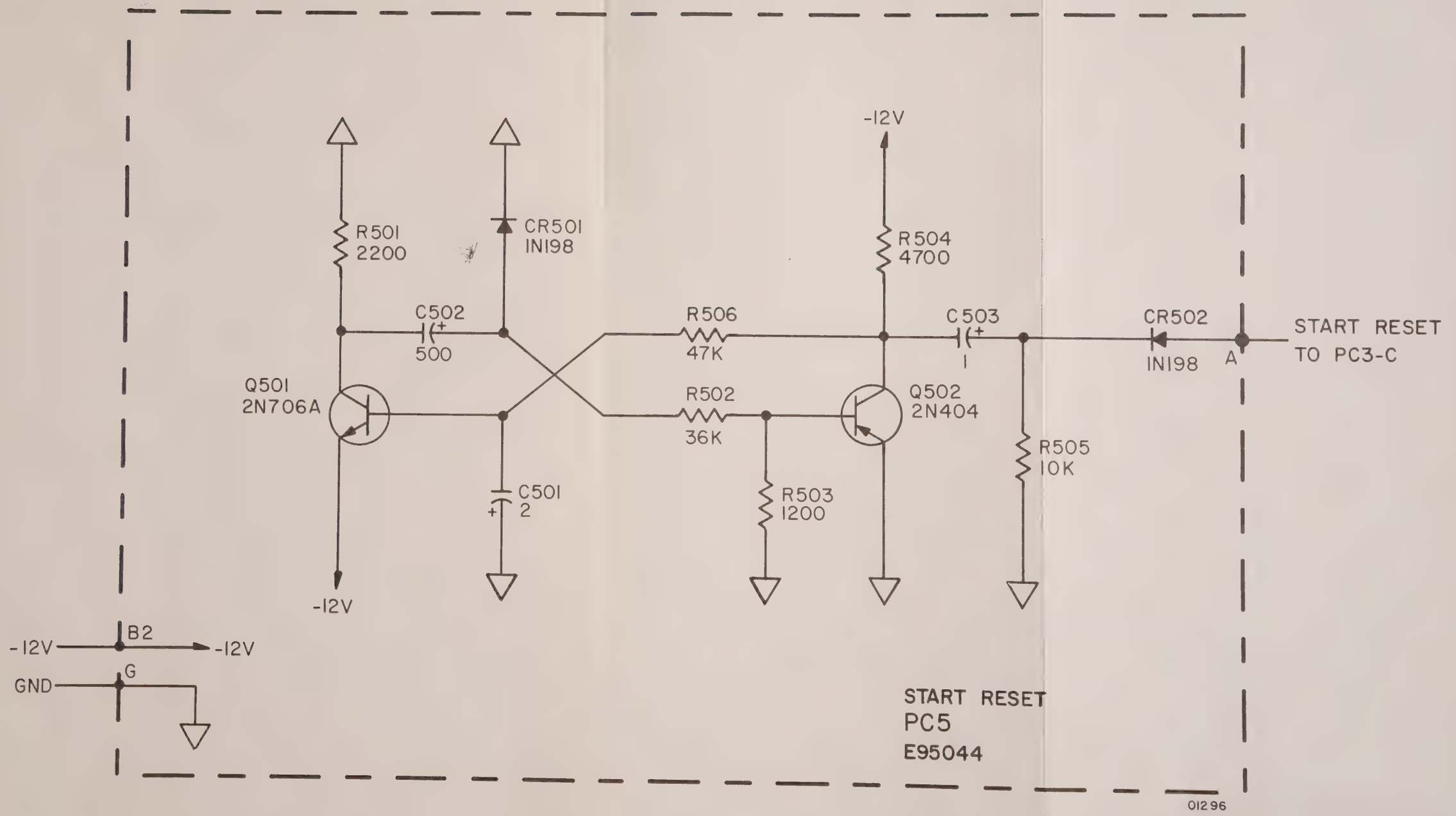


Figure 6—15. Starting Reset PC5 (E95044) Schematic Diagram.

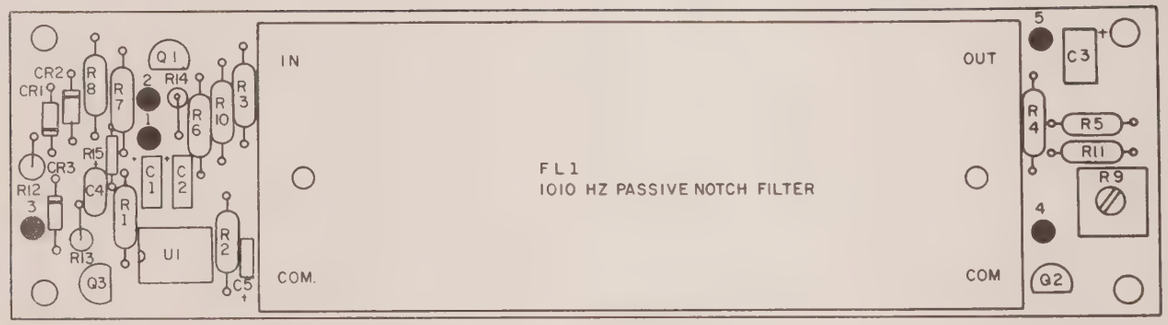
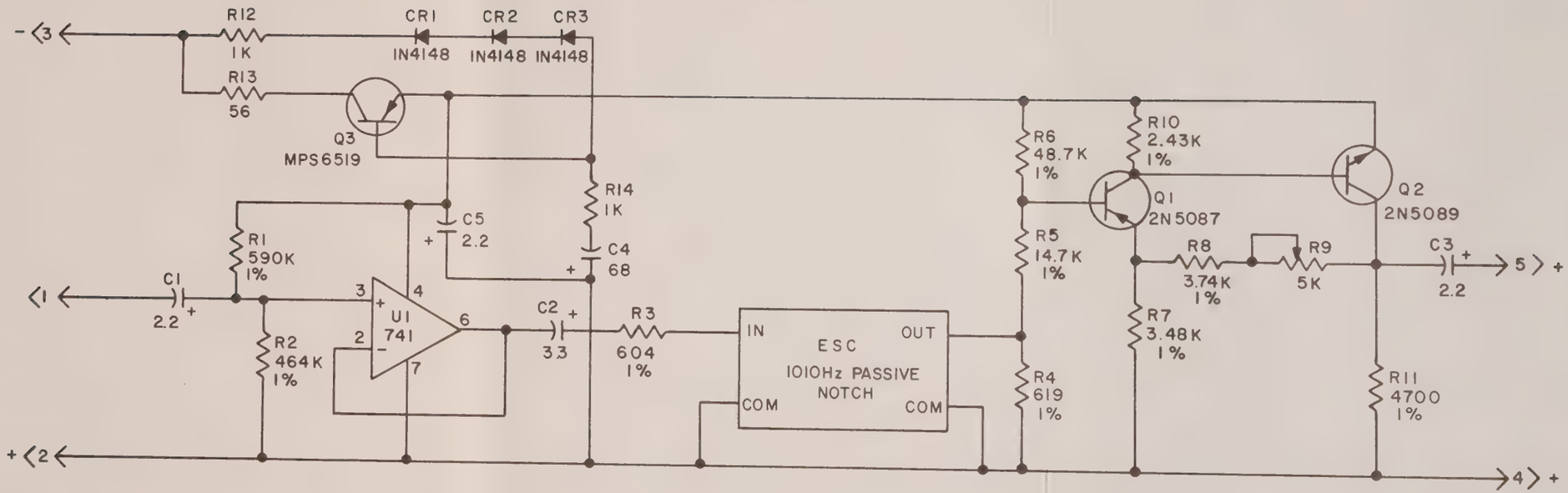


Figure 6—16. 1010 Hz Notch Filter PC8 (E96623) Component Location Diagram.



NOTES:

1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS.
   CAPACITOR VALUES ARE IN MICROFARADS.
   INDUCTANCE VALUES ARE IN MILLIHENRYS.

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Figure 6—17. 1010 Hz Notch Filter PC8 (E96623) Schematic Diagram.

SECTION 7

ELECTRONIC PARTS LISTS

7.1 INTRODUCTION.

7.2 Tables 7—1 through 7—13 are the parts lists for the TTS 58A-CN and the TTS 58AR-CN.

Table 7—1. Model TTS 58A-CN Overall Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
BP1-2	BINDING POST METAL GND				H H SMITH	137SP	652500100
C1-2	100UF			150V	SPRAGUE	TVA1420	300401071
CR2	DO-4	10W	10%	18V	MOTOROLA	1N1607	562016070
J1-2	SPECIAL				SWCRFT	5J-1329	650401300
J3	BINDING POST-RED				GRAYHILL	29-1R	652400400
J4	BINDING POST-BLK				GRAYHILL	29-1B	652400300
J5	SPECIAL				SWCRFT	5J-1191	650400900
J6	JACK,TEL,SWCRFT SCHEM 16				SWCRFT	M446A	650300300
J7-8	BINDING POST-RED				GRAYHILL	29-1R	652400400
J9-10	TEST JACK,BLK				RAYTHEON	TJ105BL	650600100
K1-3	4-DIGIT MAN.RESET				SODECO	TCEZ4E-34	728000100
L1	4H				NEWTON	TN-1274	450200200
PC1	PC1 E-95048 PC BD						A005810027
PC2	PC2 E-95045 PC BD						A005810028
PC3	PC3 E-95043 PC BD						A005810025
PC5	PC5 E-95044 PC BD						A005810023
PC6	PC6 E-95047 PC BD						A005810005
PC7	PC7 E-95046 PC BD						A005810004
PC4A	PC4A,4B,4C, PC BD 95042						A005810026
PC4B	PC4A,4B,4C, PC BD 95042						A005810026
PC4C	PC4A,4B,4C, PC BD 95042						A005810026
R42	400#	10W	5%		W LEONARD	TYPE 10XM	210604015
R111	500#	2W	20%		CRL	HML-500	232205010
R211	500#	2W	20%		CRL	HML-500	232205010
R311	500#	2W	20%		CRL	HML-500	232205010
R42A	400#	10W	5%		W LEONARD	TYPE 10XM	210604015
S1	S-1						A005810022
S2	DPST	6A		125V	J-B-T	ST26K	620100400
S3	SPST	6A		125V	J-B-T	ST16A	620100200
S4	S-4						A005810030
S5	S-5						A005810012
S6-8	S-6,S-7,S-8						A005810013
S9	DPST	6A		125V	J-B-T	ST26K	620100400
S10	DPDT	5A		28V	C&K COMP	7201TZB	620402800
S11	TIMER 60-MIN TTS58A				RHODES	71002-J	961200100
T1	AUDIO SCREW MTD				NEWTON	NES-3345C	400400300

Table 7—2. Model TTS 58AR-CN Overall Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
BP1-2	BINDING POST METAL GND				H H SMITH	137SP	652500100
C1-2	100UF			150V	SPRAGUE	TVA1420	300401071
CR2	DO-4	10W	10%	18V	MOTORCLA	1N1607	562016070
J1-2	SPECIAL				SWCRFT	5J-1329	650401300
J3	BINDING POST-RED				GRAYHILL	29-1R	652400400
J4	BINDING POST-BLK				GRAYHILL	29-1B	652400300
J5	SPECIAL				SWCRFT	5J-1191	650400900
J6	JACK,TEL,SWCRFT SCHEM 16				SWCRFT	M446A	650300300
J7-8	BINDING POST-RED				GRAYHILL	29-1R	652400400
J9-10	TEST JACK,BLK				RAYTHEON	TJ105BL	650600100
K1-3	4-DIGIT MAN.RESET				SODECO	TCEZ4E-34	728000100
L1	4H				NEWTON	TN-1274	450200200
PC1	PC1 E-95048 PC BD						A005810027
PC2	PC2 E-95045 PC BD						A005810028
PC3	PC3 E-95043 PC BD						A005810025
PC5	PC5 E-95044 PC BD						A005810023
PC6	PC6 E-95047 PC BD						A005810005
PC7	PC7 E-95046 PC BD						A005810004
PC4A	PC4A,4B,4C, PC BD 95042						A005810026
PC4B	PC4A,4B,4C, PC BD 95042						A005810026
PC4C	PC4A,4B,4C, PC BD 95042						A005810026
R42	400#	10W	5%		W LEONARD	TYPE 10XM	210604015
R111	500#	2W	20%		CRL	HML-500	232205010
R211	500#	2W	20%		CRL	HML-500	232205010
R311	500#	2W	20%		CRL	HML-500	232205010
R42A	400#	10W	5%		W LEONARD	TYPE 10XM	210604015
S1	S-1						A005810022
S2	DPST	6A		125V	J-B-T	ST26K	620100400
S3	SPST	6A		125V	J-B-T	ST16A	620100200
S4	S-4						A005810030
S5	S-5						A005810012
S6-8	S-6,S-7,S-8						A005810013
S9	DPST	6A		125V	J-B-T	ST26K	620100400
S10	DPDT	5A		28V	C&K COMP	7201TZB	620402800
S11	TIMER 60-MIN TTS58A				RHODES	71002-J	961200100
T1	AUDIO SCREW MTD				NEWTON	NES-3345D	400400300

Table 7—3. Amplifier 1 and Filters PC1 (E95048), C0058-10-027, Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C3	20UF			25V	C. DUBILIE	NLW-20-25	300902060
C4	20UF			25V	C. DUBILIE	NLW-20-25	300902060
C5	1UF			16V	SPRAGUE	TE1148	300201050
C6	SELVAL		10%		SPRAGUE	225P	320000000
C7	3UF			16V	SPRAGUE	TE1150	300203050
C8	100UF			20V	CALLINS	7-65PSD100-20-S	300901071
C9	100UF			20V	CALLINS	7-65PSD100-20-S	300901071
C10	.03UF		10%	100V	F-DYNE	PE-22.030-100-10	322103036
C11	.03UF		10%	100V	F-DYNE	PE-22.030-100-10	322103036
C12	.006UF		10%	100V	F-DYNE	PE-12.006-100-10	322106026
C13	.006UF		10%	100V	F-DYNE	PE-12.006-100-10	322106026
C14	.47UF		10%	100V	SPRAGUE	225P47491XD3	320004740
C15	.47UF		10%	100V	SPRAGUE	225P47491XD3	320004740
C16	.1UF		10%	100V	SPRAGUE	225P10491WD3	320001040
C17	.05UF		10%	100V	F-DYNE	PE-12.050-100-10	322105036
C18	.04UF		10%	100V	SPRAGUE	225P40391WD3	320004030
C14A	.033UF		10%	100V	SPRAGUE	225P33391WD3	320003330
L2	7.5MH				DELEVAN	2500-70	450300200
L3	2.7MH				DELEVAN	2500-48	450300100
L4	60MH				SANGAMO	ET204-1290-7	460101800
L5	60MH				SANGAMO	ET204-1290-7	460101800
Q1	TO5MSS	150MW		35V	RCA	2N404A	553004041
Q2	TO92MSS	310MW		40V	MOTOROLA	2N3905	552039050
Q3	TO92MSS	310MW		40V	MOTOROLA	2N3905	552039050
Q4	TO5MSS	150MW		35V	RCA	2N404A	553004041
R7	150K	1/2W	5%		AB	TYPE EB	200201545
R13	390K	1/2W	10%		AB	TYPE EB	200203946
R14	4.7K	1/2W	10%		AB	TYPE EB	200204726
R15	390K	1/2W	10%		AB	TYPE EB	200203946
R16	2.2K	1/2W	5%		AB	TYPE EB	200202225
R17	47-	1/2W	10%		AB	TYPE EB	200204706
R18	6.2K	1/2W	5%		AB	TYPE EB	200206225
R19	2.2K	1/2W	5%		AB	TYPE EB	200202225
R20	510K	1/2W	5%		AB	TYPE EB	200205145
R21	2.2K	1/2W	5%		AB	TYPE EB	200202225
R22	270-	1/2W	10%		AB	TYPE EB	200202716
R23	SEL.VAL.	1/2W			AB	TYPE EB	200200000
R24	600-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220260001
15A	.033UF		10%	100V	SPRAGUE	225P33391WD3	320003330
18A	.006UF		10%	100V	F-DYNE	PE-12.006-100-10	322106026

Table 7—4. Amplifier 2 and Monitor Amplifier PC2 (E95045), C0058-10-028, Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C19	20UF			25V	C. DUBILIE	NLW-20-25	300902060
C20	1UF			16V	SPRAGUE	TE1148	300701050
C21	20UF			25V	C. DUBILIE	NLW-20-25	300902060
C22	100UF			20V	CALLINS	7-65PSD100-20-S	300901071
C23	.1UF		00	75V	CENTRALAB	DDA-104	330201040
C24	20UF			25V	C. DUBILIE	NLW-20-25	300902060
C25	200UF			20V	IEI	APD115	300902071
C26	.001UF		10%	100V	SPRAGUE	225P10291WD3	320001020
CR-1	D041			200V	EDAL	1N4003	560040030
Q5	TO92MSS	310MW		40V	MOTOROLA	2N3905	552039050
Q6	TO92MSS	310MW		40V	MOTOROLA	2N3905	552039050
Q7	TO92MSS	310MW		40V	MOTOROLA	2N3905	552039050
Q8	TO92MSS	310MW		40V	MOTOROLA	2N3905	552039050
R25	SEL.VAL.	1/2W			AB	TYPE EB	200200000
R26	SEL.VAL.	1/2W			AB	TYPE EB	200200000
R30	390K	1/2W	10%		AB	TYPE EB	200203946
R31	2.2K	1/2W	5%		AB	TYPE EB	200202225
R32	18-	1/2W	5%		AB	TYPE EB	200201805
R33	510-	1/2W	5%		AB	TYPE EB	200205115
R34	390K	1/2W	10%		AB	TYPE EB	200203946
R35	2.2K	1/2W	5%		AB	TYPE EB	200202225
R36	270-	1/2W	10%		AB	TYPE EB	200202716
R37	1500-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220215011
R38	200K	1/2W	5%		AB	TYPE EB	200202045
R39	680-	1/2W	5%		AB	TYPE EB	200206815
R40	100-	1/2W	10%		AB	TYPE EB	200201016
R41	10K	1/2W	10%		AB	TYPE EB	200201036
TH1	1K				FENWALL	KA31L1	290101020

Table 7—5. Timing/Reset and Regulators PC3 (E95043), C0059-10-025, Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C401	.22UF		10%	100V	SPRAGUE	225P22491XD3	320002240
C402	.47UF		10%	100V	SPRAGUE	225P47491XD3	320004740
C403	100UF			20V	CALLINS	7-65PSD100-20-S	300901071
C404	.22UF		10%	100V	SPRAGUE	225P22491XD3	320002240
C405	.47UF		10%	100V	SPRAGUE	225P47491XD3	320004740
C406	100UF			20V	CALLINS	7-65PSD100-20-S	300901071
C407	200UF			20V	IEI	APD115	300902071
C408	200UF			20V	IEI	APD115	300902071
C409	200UF			20V	IEI	APD115	300902071
C410	.1UF		00	75V	CENTRALAB	DDA-104	330201040
CR401	A21	80MW		80V	TRANS.	1N198	561001980
CR402	A21	200MW		60V	TI	1N457	560004570
CR403	A21	80MW		80V	TRANS.	1N198	561001980
CR404	A21	200MW		60V	TI	1N457	560004570
CR405	A-1	400MW	5%	12V	TRNSTRON	1N759A	562007591
CR406	DO-7	400MW	10%	8.75	TRNSTRON	1N764	562007640
Q401	TO92MSS	310MW		40V	MOTOROLA	2N3905	552039050
Q402	TO92MSS	310MW		40V	MOTOROLA	2N3905	552039050
Q403	TO92MSS	310MW		40V	MOTOROLA	2N3905	552039050
Q404	TO92MSS	310MW		40V	MOTOROLA	2N3905	552039050
Q405	TO105HSS	300MW		25V	CDC	2N3638	552036380
Q406	TO105HSS	300MW		25V	CDC	2N3638	552036380
R401	10K	1/2W	10%		AB	TYPE EB	200201036
R402	10K	1/2W	10%		AB	TYPE EB	200201036
R403	120-	1/2W	10%		AB	TYPE EB	200201216
R404	1K	1/2W	10%		AB	TYPE EB	200201026
R405	470-	1/2W	5%		AB	TYPE EB	200204715
R406	120K	1/2W	10%		AB	TYPE EB	200201246
R407	4.7K	1/2W	10%		AB	TYPE EB	200204726
R408	12K	1/2W	10%		AB	TYPE EB	200201236
R409	10K	1/2W	10%		AB	TYPE EB	200201036
R410	10K	1/2W	10%		AB	TYPE EB	200201036
R411	120-	1/2W	10%		AB	TYPE EB	200201216
R412	1K	1/2W	10%		AB	TYPE EB	200201026
R413	180K	1/2W	5%		AB	TYPE EB	200201845
R414	470-	1/2W	5%		AB	TYPE EB	200204715
R415	4.7K	1/2W	10%		AB	TYPE EB	200204726
R416	12K	1/2W	10%		AB	TYPE EB	200201236
R417	1K	1/2W	10%		AB	TYPE EB	200201026
R418	3.6K	1/2W	5%		AB	TYPE EB	200203625

Table 7—6. Channel Boards PC4A, B, and C (E95042), C0058-10-026, Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R136	4.7K	1/2W	10%		AB	TYPE EB	200204726
R138	4.7K	1/2W	10%		AB	TYPE EB	200204726
C101	1UF			16V	SPRAGUE	TE1148	300201050
C102	100UF			20V	CALLINS	7-65PSD100-20-S	300901071
C103	1UF			16V	SPRAGUE	TE1148	300201050
C104	1UF			16V	SPRAGUE	TE1148	300201050
C105	1UF			16V	SPRAGUE	TE1148	300201050
C106	.22UF		10%	100V	SPRAGUE	225P22491XD3	320002240
C107	.0015UF		10%	100V	SPRAGUE	225P15291WD3	320001520
C108	100UF			20V	CALLINS	7-65PSD100-20-S	300901071
C109	100UF			20V	CALLINS	7-65PSD100-20-S	300901071
C110	50UF			16V	SPRAGUE	TE1160	300205060
CR101-111	A21	80MW		80V	TRANS.	1N198	561001980
CR112	D041			200V	EDAL	1N4003	560040030
Q101	TO92MSS	310MW		40V	MOTOROLA	2N3905	552039050
Q102	TO92MSS	310MW		40V	MOTOROLA	2N3905	552039050
Q103	TO5MSS	150MW		24V	RCA	2N404	553004040
Q104	TO5MSS	150MW		24V	RCA	2N404	553004040
Q105	TO92MSS	310MW		40V	MOTOROLA	2N3905	552039050
Q106	TO5HNS	1W		65V	RCA	2N2102	550021020
R114	390K	1/2W	10%		AB	TYPE EB	200203946
R116	4.7K	1/2W	10%		AB	TYPE EB	200204726
R117	270-	1/2W	10%		AB	TYPE EB	200202716
R118	47K	1/2W	10%		AB	TYPE EB	200204736
R119	68K	1/2W	5%		AB	TYPE EB	200206835
R120	4.7K	1/2W	10%		AB	TYPE EB	200204726
R121	4.7K	1/2W	10%		AB	TYPE EB	200204726
R122	680-	1/2W	5%		AB	TYPE EB	200206815
R123	10K	1/2W	10%		AB	TYPE EB	200201036
R124	10K	1/2W	10%		AB	TYPE EB	200201036
R125	47K	1/2W	10%		AB	TYPE EB	200204736
R126	120-	1/2W	10%		AB	TYPE EB	200201216
R127	4.7K	1/2W	10%		AB	TYPE EB	200204726
R128	470-	1/2W	5%		AB	TYPE EB	200204715
R129	12K	1/2W	10%		AB	TYPE EB	200201236
R130	12K	1/2W	10%		AB	TYPE EB	200201236
R131	10K	1/2W	10%		AB	TYPE EB	200201036
R132	10K	1/2W	10%		AB	TYPE EB	200201036
R133	47K	1/2W	10%		AB	TYPE EB	200204736
R134	4.7K	1/2W	10%		AB	TYPE EB	200204726
R135	10K	1/2W	10%		AB	TYPE EB	200201036
R137	100-	1/2W	10%		AB	TYPE EB	200201016
R139	56-	1/2W	5%		AB	TYPE EB	200205605
XQ102	SKT				ELCO	05-3303	826600100

Table 7—7. Starting Reset PC5 (E95044), B0058-10-023, Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C501	2UF			16V	SPRAGUE	TE1149	300202050
C502	500UF			15V	MALLORY	TT15X500	300905071
C503	1UF			16V	SPRAGUE	TE1148	300201050
CR501	A21	80MW		80V	TRANS.	1N198	561001980
CR502	A21	80MW		80V	TRANS.	1N198	561001980
Q501	TO18MSA	300MW		24V	GE	2N706A	550007060
Q502	TO5MSS	150MW		24V	RCA	2N404	553004040
R501	2.2K	1/2W	5%		AB	TYPE EB	200202225
R502	36K	1/2W	5%		AB	TYPE EB	200203635
R503	1.2K	1/2W	10%		AB	TYPE EB	200201226
R504	4.7K	1/2W	10%		AB	TYPE EB	200204726
R505	10K	1/2W	10%		AB	TYPE EB	200201036
R506	47K	1/2W	10%		AB	TYPE EB	200204736

Table 7—8. Input Termination PC6 (E95047), A0058-10-005, Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R1	475-	1/2W	1%		ELECTRA	RN65 SIZE 100 PPM	220647501
R2	316-	1/2W	1%		ELECTRA	RN65 SIZE 100 PPM	220631601
R3	68.1-	1/2W	1%		ELECTRA	RN65 SIZE 100 PPM	220668191
R4	475-	1/2W	1%		ELECTRA	RN65 SIZE 100 PPM	220647501
R5	316-	1/2W	1%		ELECTRA	RN65 SIZE 100 PPM	220631601
R6	68.1-	1/2W	1%		ELECTRA	RN65 SIZE 100 PPM	220668191

Table 7—9. Attenuator Padding PC7 (E95046), A0058-10-004, Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R112	750-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220275001
R113	SEL.VAL.	1/2W			AB	TYPE EB	200200000
R212	750-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220275001
R213	SEL.VAL.	1/2W			AB	TYPE EB	200200000
R312	750-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220275001
R313	SEL.VAL.	1/2W			AB	TYPE EB	200200000

Table 7—10. 1010 Hz Notch Filter PC8 (E96623), B0001-10-014, Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	2.2UF		10%	35V	KEMET	T330A225K035AS	310002250
C1-3	D035	500MW		75V	FAIRCHILD	1N4148	560041480
C2	3.3UF		10%	25V	KEMET	T330A335K025AS	310003350
C3	2.2UF		10%	35V	KEMET	T330A225K035AS	310002250
C4	120UF	G	10%	15V	SPRAGUE	196D127X9015TE4	310801270
C5	2.2UF		10%	35V	KEMET	T330A225K035AS	310002250
FL1	1010 HZ				ESC ELECT.	ESC 42F86	470100700
Q1	TO92				MOTOROLA	2N5087	552050870
Q2	TO92				MOTOROLA	2N5089	550050890
Q3	TO92AFA	310MW		25V	MOTOROLA	MPS6519	552065190
R1	590K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220259031
R2	464K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220246431
R3	604-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220260401
R4	619-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220261901
R5	14.7K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220214721
R6	48.7K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220248721
R7	3480-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220234811
R8	3740-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220237411
R9	5K	1/2W	10%	200V	HELIPOT	72PMR5K	232705023
R10	2430-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220224311
R11	4.7K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220247011
R12	1K	1/4W	10%		AB	TYPE CB	200101026
R13	56-	1/4W	10%		AB	TYPE CB	200105606
R14	20K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220220021
R15	1K	1/4W	10%		AB	TYPE CB	200101026
U1	8PDIL				NAT. SEMI	LM741CN	500007412

Table 7—11. Switch Assembly S1, A0058-10-022, Parts List.

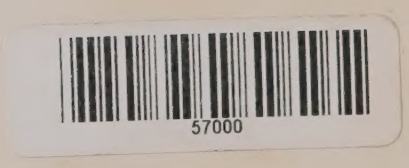
REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R43	40.2K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220240221
R44	40.2K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220240221
R45	80.6K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220280621
R46	1000-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210011
S1	5D-2CKT-5 POS	SHORT			OAK	269427-F5	625801100

Table 7—12. Switch Assembly S4, A0058-10-030, Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R8	24.21K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220224221
R9	816.3-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220281601
R10	3.435K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220234311
R11	22K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220222021
R12	7.9K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220279011
R27	410.2-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220241001
R28	129.8-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220212901
R29	60-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220260091
S4	4D-1CKT-11POS		SHORT		OAK	269425-F4	625800900

Table 7—13. Switch Assemblies S6, S7 and S8, A0058-10-047, Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R101	2.056K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220200007
R102	1.6337K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220216311
R103	1.2977K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220212911
R104	1.0308K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210311
R105	818.8-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220281801
R106	650.4-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220265001
R107	516.6-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220251601
R108	410.2-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220241001
R109	326-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220232601
R110	258.9-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220225801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